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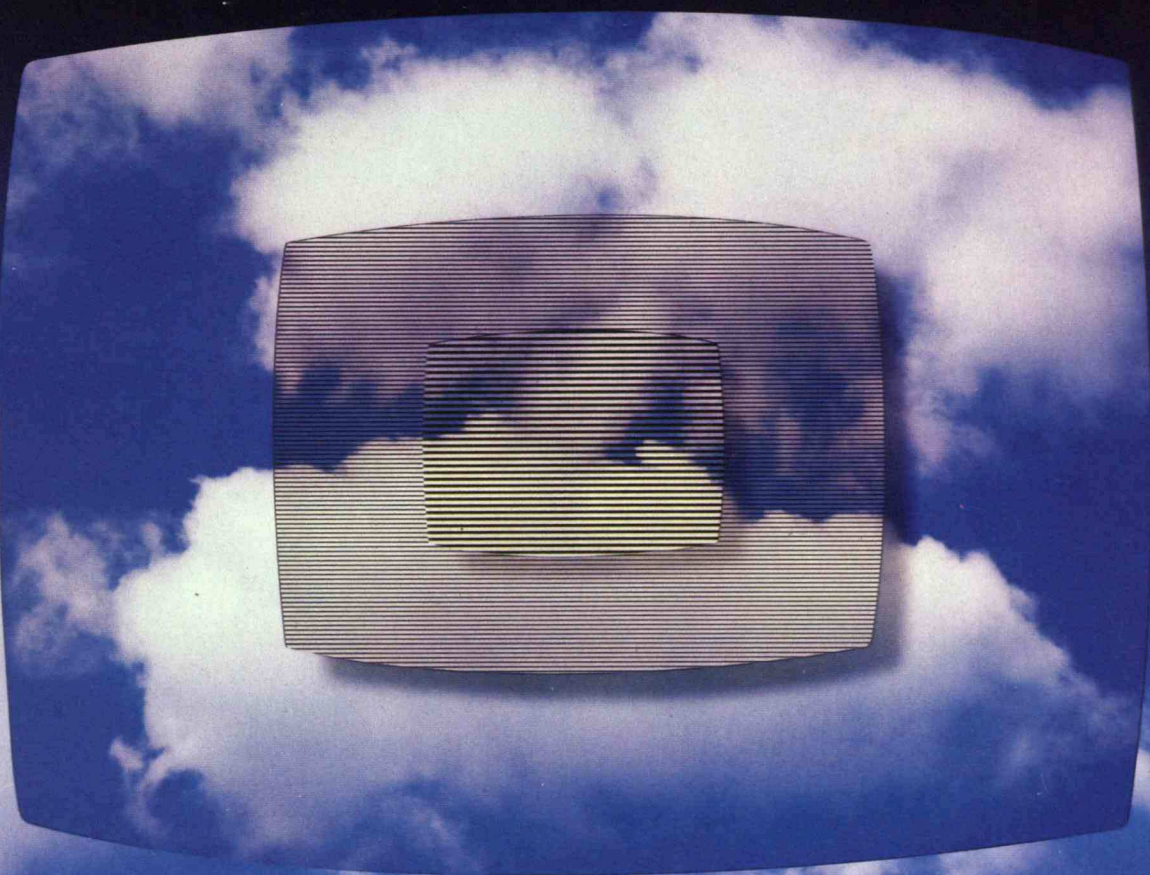
■ HOW AIR POLLUTION HARMS OUR FORESTS ■

TechnologyReview

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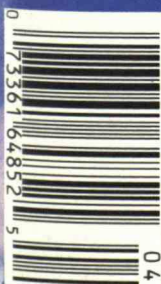
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CHOOSING THE TV OF THE FUTURE

THE DEBATE OVER
HIGH-DEFINITION TELEVISION



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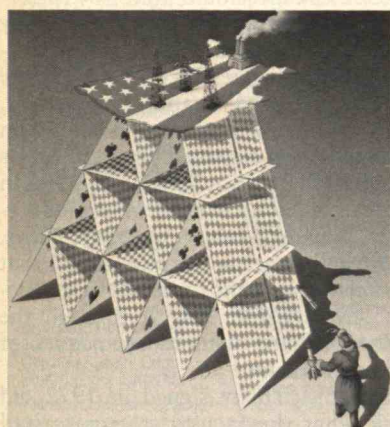
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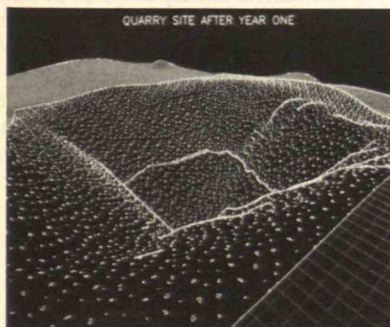
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FIRST LINE

FROM THE EDITOR

March 4, 1969

A GAINST the backdrop of the Vietnam War, much of the MIT community stopped work on March 4, 1969, to spend the day discussing the role of scientists and engineers in society. March 4 was remarkable for its lucid examination of concerns about researchers' relationship with the military, government, and society. A decade earlier few recognized these concerns. Talks held to commemorate the twentieth anniversary of March 4 surely demonstrate that we are still grappling with the questions as they were framed that day.

Physics graduate students originated the idea for the event. They organized the Science Action Coordinating Committee (SACC) to plan it, and 48 faculty members formally proposed March 4 to the MIT community. Panel discussions were chaired by such distinguished faculty as Bernard T. Feld, subsequent editor of the *Bulletin of Atomic Scientists*; Francis E. Low, later MIT provost; Salvador Luria, Nobel laureate in biology; and Robert Probst of the Mechanical Engineering Department.

What separated March 4 from so many similar events may have been the way it grew from the scientific milieu of MIT. Scientists and engineers recognized that their research had immense consequences and were willing to discuss them. They had already gone a step beyond the few humanists who spoke. Howard Zinn, a Boston University historian, devoted his talk to criticizing the call to "disinterested scholarship," scholarship that refuses to acknowledge itself as a force for social change. MIT did not need to engage in the great liberal-arts debate about "relevance."

The faculty statement proposing March 4 announced that the goal was social: "Misuse of scientific and technical knowledge presents a major threat to the existence of mankind." The signers called for "concrete action" against such dangers, including "ill-advised and hazardous projects such as the ABM [antiballistic missile] system." They were not afraid to admit mistakes, but, as Victor Weisskopf, physics professor at MIT, said, "We scientists are optimists." In a frank, even experimental way, the speakers took up the question of how their work could produce beneficial rather than harmful effects.

They sought to discover fundamental causes of problems. Eugene Rabinowitch, editor of the *Bulletin of Atomic Scientists*,

a physicist on the Manhattan Project, and a refugee from Soviet Russia and Nazi Germany, argued that what had been "tolerable or even good in the past"—the self-centered nation state—was now "obsolete and deadly." The nation was the source of the arms race. Hope lay in science, "the first common enterprise of mankind."

Many speakers, especially students on a panel organized by SACC, called for change, but few proposed mechanisms to effect it. Most could assent to the call by Noam Chomsky, MIT professor of linguistics, for "serious commitment and determined action." One thing that stood in the way of discussing action was a widespread, though not always explicitly acknowledged, disagreement on what direction change should take.

Still, change did come. Along with many other major universities, MIT stopped accepting classified research. In 1973, the Institute divested Draper Laboratory, which at the time performed \$90 million a year of largely classified research. MIT's arms-length relationship with Lincoln Laboratory, which does classified research, remains a subject of debate today. But by and large, universities found that their role as scientific "arsenals of democracy" from World War II through the 1950s conflicted with the principles of open scholarship.

The ABM Treaty signed in 1972 did check what the faculty statement had called the "ill-advised and hazardous" antiballistic-missile system (and, in some measure, its offspring, the Strategic Defense Initiative). But, of course, the arms race continued. The multiple-warhead missile—an innovation under development in the late 1960s but little discussed on March 4—was the next big step.

If the problems of two decades ago have not been solved, neither have they been forgotten. An institution that resulted directly from March 4 is still dealing with many of them. The faculty committee that proposed the event called itself the Union of Concerned Scientists. Out of the committee grew the well-known national organization that has sought to ensure, in the words of the original statement, "a more humane and civilized world."


JONATHAN SCHLEFER

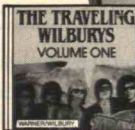
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264134. D.J. Jazzy Jeff &
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200478. Metallica: *And
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223559. The Beach Boys:
Endless Summer • 21
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100532. Diane Schuur:
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100603



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100707

105392. Pops In Space
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Strikes Back, more. (Philips
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153582. Tracy Chapman
*Fast Car, Talkin' 'Bout A
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164165. Bobby McFerrin:
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Juliet; Nutcracker Suite*
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de lune, many more. (MCA)

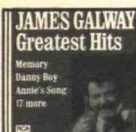
100035. Robert Palmer:
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Irresistible, More Than
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123385. The Best Of Eric
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100579. K. T. Oslin: *This
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100470. Vangelis: *Direct
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The Wind*, etc. (Arista)

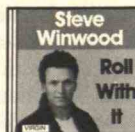
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100679. Steve Earle:
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153606. INXS: *Kick* • Need
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etc. (Atlantic)

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100927

153740. Genesis:
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163579. Andrés Segovia
*Plays Rodrigo, Ponce &
Torroba* • Fantasia para un
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Oil Overcharges and Military Waste

EXXON'S PLIGHT

"Un-Crude Answers" by Felicity W. Evans (July 1988) incorrectly implies that the disputed oil-pricing case involving the Hawkins Field in Texas is an example of "price gouging" and "colluding to evade energy price controls."

As the operator of the field, Exxon told the Department of Energy about the pricing procedures it intended to follow. DOE later disallowed Exxon's interpretation of pricing regulations because the department wanted to retroactively apply new rules. As a result, the company had to refund the amount of the alleged overcharge plus interest. However, the judge in the case declined to impose a fine or other civil penalty because Exxon had been completely aboveboard with the government regarding pricing procedures.

HENRY LARTIGUE
Houston, Tex.

Henry Lartigue is the manager of the public affairs department at Exxon.

The author responds:

The Emergency Petroleum Allocation Act, which used to establish procedures for allocating fuel and setting price controls, was incredibly complicated. Les Adams, previously deputy solicitor of the DOE Economic Regulatory Administration and now special assistant to the undersecretary, has noted that DOE auditors could not keep up with the required paperwork. The resulting delays may have led to confusion between Exxon and DOE on the company's interpretation of pricing regulations.

Nonetheless, the facts in the Hawkins Field case speak for themselves: the judge agreed with DOE that Exxon had overpriced crude oil. That is what I wrote, and I stand by it. I did not say Hawkins Field exemplifies a general tendency toward "price gouging." There have been hundreds of oil-overcharge cases, and I did not mean to suggest that Exxon is guilty of every known violation.

WASTE FROM WEAPONS

"Radioactive Waste: The Hidden Legacy of the Arms Race" by Robert Alvarez and Arjun Makhijani (*August/September 1988*) is an inaccurate and misleading account of the military's waste-management operations, for which I had lead responsibility with the Atomic Energy Commission during the 1960s and 1970s. Highly radioactive waste has been and is being

produced at only 3 Department of Energy sites, not 20 as the authors state. Moreover, "dilution is the solution to pollution" is not and has never been the philosophy or the practice of the DOE or the Atomic Energy Commission. On the contrary, plants have many evaporators and ion-exchange systems for concentrating highly radioactive wastes. And groundwater is extensively monitored at storage sites, not just at plant boundaries as Alvarez and Makhajani assert.

Wastes at Hanford and Savannah River are and always have been stored in a manner that poses no threat to the public or workers. They are not contaminating—nor do they threaten to contaminate—public water supplies. Large amounts of highly radioactive waste have indeed leaked from tanks into the soil at Hanford. However, the plant is in a desert, and the tanks are located more than 200 feet above the water table. In addition, there is no mechanism for moving waste to the water table: Hanford receives approximately seven inches of rainfall a year, which evaporates from the soil surface. And even if large amounts of water were added, most radionuclides would be adsorbed on the soil by ion exchange and not transported in significant quantities. It is also worth noting that for many years, wastes at Hanford have been evaporated so that they solidify within the tanks and are stored as an immobile salt.

At the Savannah River Plant, waste is stored in "tanks within tanks," which means that any leaks from an inner tank can be pumped from the space between it and the outer tank into a third tank. In one instance almost 30 years ago, an outer tank leaked, but analysis has shown that ion exchange fixed the radioactivity in the immediate vicinity of the tank. As at Hanford, wastes are immobilized by converting them to salt, pending availability of facilities for long-term isolation.

During the 1960s and early 1970s, radioactive waste-management practices at the Idaho Falls chemical-processing plant had deteriorated, with the waste calciner facility, which performed an operation Alvarez and Makhajani endorse, posing the greatest danger. Processing significantly smaller amounts of waste than those at Hanford and Savannah River, workers at Idaho Falls received two to three times the radiation exposure. The waste calciner gave off sizable quantities of radioactive particulates. Although a filter removed

much of these, large amounts could have been released to off-site locations in the event of a filter fire. Replacing the old calciner facility with a newer one led to significant improvements, but even so, calcination offers little advantage compared with turning waste into a solid salt through evaporation. In addition, calcining is much more complex. And neither calcining nor turning waste into a solid salt works well for long-term isolation.

Alvarez and Makhajani claim that an earthquake could destroy Savannah River's waste tanks. However, the tanks are encased in heavily reinforced concrete 2.5 feet thick, and nationally recognized earthquake consultants have concluded that the tanks could withstand quakes.

Perhaps the worst of all the authors' statements is that explosive gases produced in waste tanks could blow them open, creating a Chernobyl-scale accident. This is not possible in any Department of Energy tank. The hydrogen that would be necessary for an explosion is produced in significant quantities only in tanks containing fresh waste. Moreover, hydrogen is continually removed by forced ventilation, and there are alarms to warn of ventilation failure. Levels of the gas are routinely analyzed to assure that concentrations are well below the explosive limit. Emergency power and spare blowers are available if equipment fails, and personnel would have over 13 days to take corrective action. In the very unlikely event of a hydrogen explosion and under the most pessimistic assumptions, calculations indicate that less than a gallon of waste would be dispersed. Although such a release would contaminate the area around the tanks, it could be cleaned up without significant exposure to workers or the public.

I also object to the criticism of Savannah River's glassification facility for processing waste, which is built with remote operation and maintenance features similar to those successfully used since the early 1940s. The suggestion that a spill would cripple operations implies a lack of understanding of remote capability. Equipment for the facility has been fully tested, and those tests have been paralleled by pilot-scale demonstration using highly radioactive waste. The technical uncertainties are no greater than those of other technologies successfully started at Savannah River on a first-of-a-kind basis. And building a pilot plant, as the authors recommend, would cost almost as much as

This month we print some of the many letters we have received on our article about military radioactive waste. More will appear in the May/June issue.

the processing facility itself and pose similar hazards.

A final note: Alvarez and Makhajani are right that we should discontinue production of plutonium for weapons. We should have done so two decades ago. They are also right that waste-management practices should be improved and independent oversight provided. But what is needed most is an accurate account of what has been done in the past, what is being done now, and what is planned.

CLINTON BASTIN
Blue Ridge Summit, Pa.

As a former senior Department of Energy (DOE) nuclear-waste engineer, I was pleased to see the article by Alvarez and Makhijani. Self-regulation has led to major problems at every DOE facility.

In the past, DOE requested limited oversight by the National Academy of Sciences. But I know from experience that that oversight could be uneven. The NAS and I both conducted reviews of the Savannah River Plant in 1980, and although the academy found nothing seriously wrong with any radioactive-waste operation, I documented extensive surface and sub-surface contamination.

Du Pont, the company in charge at Savannah River, asked DOE to make my report inaccessible to the academy and the public. DOE complied. And a year later, when I suspected—correctly—that chlorocarbons from a Savannah River seepage basin had contaminated the Tuscaloosa aquifer and plant drinking water, I was removed from investigating that basin. Nonetheless, once my criticisms became public, Du Pont changed. It closed the more seriously contaminated seepage basins. Outside consultants and the South Carolina state government have become partners in a plant-wide cleanup. I applaud Du Pont for these efforts.

Unfortunately, Westinghouse—the current operator of the Hanford, Wash., site, which has more radioactive-waste problems than any other DOE facility—is now taking over Savannah River. Westinghouse is still using cardboard boxes to dispose of radioactive waste at Hanford. A request by President Truman brought Du Pont to the Savannah River Plant, and I believe only a request by President Bush would keep Du Pont there long enough to finish the cleanup.

DOE is overburdened with administering and regulating the nuclear-weap-

ons programs. The Nuclear Regulatory Commission, the Environmental Protection Agency, and state governments should assume regulatory responsibilities. However, it is up to scientists and engineers to assure that management never again self-regulates a technical process. If we consider the \$100 billion required to clean up DOE operations, independent oversight becomes an investment in public safety and rigorous science, not a cost.

W.F. LAWLESS
Blacksburg, Va.

The authors respond:

For having had the lead responsibility for the Atomic Energy Commission's military-waste operations, Mr. Bastin is surprisingly unfamiliar with its enormous and complex historical records. He claims that an explosion is "not possible in any Department of Energy tank," yet Savannah River's safety-analysis report and a number of other official documents all admit that such explosions are possible. In fact, extended failures of ventilation systems designed to prevent a buildup of hydrogen or organic vapors have already occurred at Savannah River. On two occasions hydrogen buildup has equalled or exceeded the safety limit.

Bastin is also mistaken in saying there is "no mechanism" for moving radioactive wastes into groundwater at Hanford. Large quantities of radioactive wastes have been pumped directly into the groundwater there. This is apart from the radioactivity that has accumulated in the soil from dumping and leaks. Moreover, in implying that we say groundwater is not monitored on site, Bastin has misread our article. Our point, clearly stated, is that pollutants are regulated at the site boundary, which has allowed DOE to pollute plant sites with impunity.

Finally, Bastin is wrong to claim that a severe earthquake would disperse only 1.3 gallons of radioactivity per tank. Such a quake would destroy much or most of a tank farm, and tens or hundreds of millions of curies of radiation would be discharged into the soil and groundwater (some of the tanks at Savannah River are partly below the water table). The site would be very difficult or impossible to clean up. Perhaps Bastin does not recall the incident in March 1976 when a cleanup of a spill of only 50 curies at Savannah River had to be stopped because of excessive radiation doses.

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Exporting Hazardous Waste

Governments are moving swiftly to defuse a potential international time bomb. The conflict centers on increasing shipments of the developed world's industrial waste to Third World nations.

"We're in effect getting ready to export Love Canal overseas," warns Rep. John Conyers (D-Mich.), who is sponsoring legislation on the issue. The Organization of African Unity, one of several international bodies working to curb such shipments, calls

the practice "toxic terrorism" and has condemned it on African territory.

The attraction of Africa, Latin America, and the Caribbean as dump sites has emerged with tightening regulations on treating and dumping in Europe and North America. The cost of shipping toxic incinerator ash, sewage sludge, refinery tailings, and other wastes overseas can be as little as a tenth the cost of treating them in the developed world.

Even garbage from homes is becoming difficult to dis-

pose of. "Landfills are closing, and many towns can't afford the insurance on those fills that remain," says Wendy Greider, an international-affairs specialist at the Environmental Protection Agency (EPA). "Options are drying up for the legal disposal of waste in this country."

EPA is receiving a soaring number of official notifications about hazardous waste that will be shipped overseas. The agency recorded 30 such notices in 1980, the first year it required them. After Congress tightened the rules in

1986, the figure rose to 465 in 1987 and reached more than 500 midway through 1988. Moreover, although EPA monitors hazardous-waste shipments, requiring a permit from the receiving country, no notice is needed to export a wide range of other materials—from common garbage to untreated sewage to incinerator ash.

The spread of advanced technology to the Third World further complicates the toxic-dumping issue. Peru is considering building the Third World's first incinerator that could handle industrial waste; Guyana recently rejected the idea. But incinerators raise their own environmental alarms—chiefly over air pollution. They could also attract shipments to less technically advanced countries, where a breakdown could result in massive problems.

For their part, Third World nations see toxic-waste trade as a source of much-needed cash. In Africa, an aborted agreement to accept toxic wastes from the United States and Europe would have earned Guinea-Bissau more than its entire gross domestic product.

Not in My Country

However, developing nations are increasingly unwilling to continue accepting wastes. For over a year, the *Khian Sea*, a freighter bearing toxic incinerator ash from Philadelphia, sailed international

This West German freighter is accused of dumping thousands of tons of Italy's toxic wastes near the port of Koko, Nigeria.



waters seeking a dump site. Panama, the Bahamas, Bermuda, the Dominican Republic, and Honduras all rejected the ash.

In October 1987 Haiti's Department of Commerce agreed to take the ash, but rescinded the permit after Greenpeace alerted it to hazards. By then, 3,000 tons of ash had been spread on a beach on Haiti's northern coast. Tests later revealed high levels of cadmium, arsenic, mercury, and dioxins at the site.

Since 1987, several African countries, notably Guinea and Nigeria, have also toughened controls. In June 1988, Guinea arrested the Norwegian consul general for his alleged role in a scheme to import 15,000 tons of U.S. toxic wastes. Because of diplomatic immunity, he was released, but the case provided a warning that Guinea is ready to resist the illicit waste trade. Similarly, after being left with 4,000 tons of Italy's industrial and nuclear waste, Nigeria threatened to execute anyone guilty of importing toxic waste for profit.

On a variety of levels, other governments are moving to regulate the trade. The United Nations Environmental Program (UNEP) planned to consider a draft treaty regulating the export of toxic wastes at its March 1989 meeting, if negotiators can reach a consensus by that date. However, a 1988 UNEP meeting in Geneva produced confrontation as well as cooperation. "It has already become a racism issue, a North-South issue," says EPA's Greider, who attended the Geneva sessions. UNEP wants to reduce hazardous-waste shipments, but developed nations want exports to remain an option.

Reaching consensus has not been easy within the

United States, either. Several bills languished in Congress last year. Conyers's proposal would have banned all waste exports, including those now unregulated, such as common garbage and sewage. It would have let existing bilateral agreements stand, allowing exports to Canada and Mexico. But it would have prohibited agreements with other countries. A bill by Sen. Robert Kasten (R-Wis.) called for a lengthy process permitting exports that met minimum EPA guidelines for waste disposal in this country. Rep. John Porter (R-Ill.) sponsored legislation incorporating features of both proposals. Most likely, one compromise bill will be introduced in 1989.

Western Europe is also acting to limit waste exports. The European Economic Community has adopted directives that would require waste handlers to notify recipient nations of what they will get. The handlers must ensure that recipients can handle the wastes properly, too. But only Belgium, Greece, and Denmark have transformed the directives into law.

As some nations ban dumping, "the battle line shifts," warns Jim Vallette of Greenpeace USA. Eastern Europe has lately become a zone of increased dumping activity. West Germany alone ships 600,000 tons of hazardous waste each year to East Germany. And the *Khian Sea*, renamed the *Pelicano*, recently showed up in Singapore with its cargo hold empty. The captain says he unloaded its waste cargo legally, but Greenpeace suspects it was dropped into the ocean, violating U.S. law. ■

JOEL MILLMAN is a free-lance journalist living in Central America.

Forensic Meteorology



You won't see them on television, but new expert witnesses often star in weather-related accidents that end in court. Like detectives investigating crimes, forensic meteorologists reconstruct the sequence of environmental events that leads to accidents.

Many credit the National Weather Service's Oscar Tenenbaum with starting the field. In addition to being chief meteorologist at Boston's Logan Airport from 1950 to 1972, Tenenbaum was a practicing lawyer. His familiarity with the courtroom led him to offer his expertise in cases where weather was a factor.

One of Tenenbaum's cases illustrates the work of a forensic meteorologist. When the blizzard of 1978 struck the Northeast, it destroyed homes miles from the seashore, apparently by flooding. Although the owners' insurance didn't cover flood damage, several of them sued the insurance companies in a case that lasted years.

The home owners hired Tenenbaum, and his investigation of weather records found that hurricane-force winds had preceded the flooding. He theorized that strong winds

After the 1978 blizzard struck these homes in the Northeast, forensic meteorologists helped several owners recover insurance damages.

had demolished the homes, and water simply covered them later. Since the insurance policies included wind damage, two home owners won settlements based on Tenenbaum's findings.

Although the term forensic meteorology didn't even exist a few years ago, over 20 consulting firms with scientists certified by the American Meteorological Society now provide the service. Litigation continues to account for the demand for forensic meteorology services, and these companies supplement Weather Service data with technology as complex as radars that can detect severe weather far away, and as simple as automated recording instruments that send readings to a personal computer.

However, the meteorologist's expertise is still key. Consider accidents where someone has slipped on ice. These routine cases comprise most forensic meteorology investigations. If ice has been on the ground for a reasonable length of time, an owner who does not attempt to remove it

is at fault. The forensic meteorologist must make a professional judgment about the length of time ice has been on the ground.

The Rain on the Plain

To amass a much more detailed, accurate history than the National Weather Service provides, most forensic companies have developed extensive observation networks. The services use a variety of methods to collect data reports, using technology as basic as public telephones with automated recording equipment. On the high-tech end, very-high-frequency radio communication systems that bounce signals off meteor trails have proven to be a reliable and relatively inexpensive way to transmit data from remote locations such as Alaska.

For example, R-Scan Corp., based in Minneapolis, recently started a forensic service for lightning damage. R-Scan maintains receivers that can pinpoint an individual lightning stroke in the continental United States to within a quarter mile. A commercial operation, R-Scan provides much the same service to its customers as the National Lightning Detection Network, based at the State University of New York at Albany, does for researchers. In fact, R-Scan supplied some equipment for the network.

Previously, insurance companies often couldn't verify or challenge lightning-damage claims, says Mark Corona, an engineer and a vice-president of R-Scan. Some claimants took advantage of this, he believes. Now insurance companies specify the approximate time and location of an alleged strike, and R-Scan's computers search their files to determine whether

lightning was the likely cause of reported damage.

R-Scan has helped several insurance companies disprove claims. A Minnesota company submitted a \$10,000 claim for a computer system, citing lightning as the cause of damage. R-Scan showed there was no lightning on the day the system was allegedly damaged.

New England Weather Sciences employs the increased storage capacity of personal computers to handle data from a network of 15 weather observers in the Boston area, plus several in New Hampshire and Maine. "Each day observers phone in observations that are used for local forecasts. The information is then archived on a personal computer for forensic work," says meteorologist Rob Gilman, founder of New England Weather Sciences. In addition, the firm records observations sent in by small airports and utility companies. Gilman finds this wealth of data critical in New England, where weather conditions can vary dramatically in a relatively small area. It may be raining at Logan Airport, but snow can be falling a few miles inland.

Finally, Weather Surveys of New York handled a novel case in which stockholders sued the operator of several Kentucky coal mines. After two mines went broke, the stockholders believed they had been misled when investing. The operator said that heavy snow contributed to the financial troubles. He hired Conrad Gosset of Weather Surveys, who produced 15 years' worth of snowfall records that showed the snowfall was indeed heavier than normal. The operator won the suit. ■

SALVATORE SALAMONE is a free-lance science writer.

Smart Materials

The man yanks the flexible fishing rod back in a high arc and whips it to the "hot" spot. The line descends and a big fella strikes. As the fish tugs on the line, the rod miraculously stiffens. When the fish slows its battle, slackening the line, the rod flexes.

This fish story employs one in a repertoire of concepts under development at the Michigan State University (MSU) Intelligent Materials and Structures Laboratory. Unlike the typical tale of its genre, it's not as outlandish as it sounds.

"Smart" materials that adjust their physical properties to fit changing conditions may be years away from consumer applications like fishing rods, but the Department of Defense and major aerospace companies are interested now, reports MSU mechanical engineer Mukesh Gandhi. Under a U.S. Army research grant, Gandhi and his colleague Brian Thompson are developing a prototype helicopter rotor blade that stiffens and relaxes as the stresses on it vary.

The same advanced technology might yield airplane wings that adjust to changing temperature, fuel weight, turbulence, humidity, and speed.

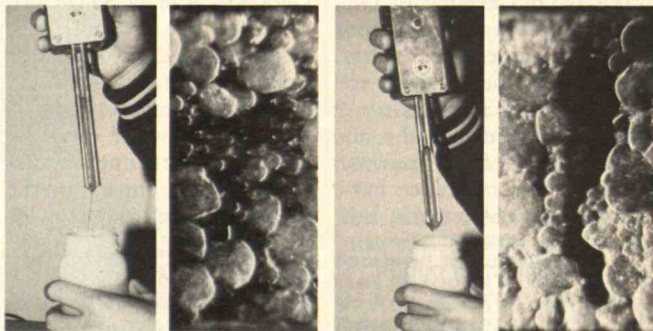
Materials that quickly adapt to their environment could also benefit high-speed machinery, hydraulic pumps, valves, motors, and earthquake-resistant buildings.

Consumer applications include a car suspension that adjusts to rough and smooth roads and a golf club that is nice and whippy for the swing but becomes rigid upon contact with the ball. And the smart fishing rod.

To create smart materials, Gandhi and Thompson unite three technologies. The first, electro-rheological (ER) fluids, thicken in as little as microseconds when they are exposed to weak electrical fields, as if from milk to cream to butter, says University of Michigan materials scientist Frank Filisko. Long-known but little-used, ER fluids are emerging from obscurity as military and industrial laboratories around the world begin to appreciate their talent.

These fluids are made primarily of a nonconducting oil with fine particles suspended in it. Until recently the fluids also contained water, which the particles absorbed when they were heated. As the water was drawn off, the fluids became unstable and their re-

Electro-rheological fluids and their molecular structure are shown in the two photos to the left. At right, exposed to an electrical field, the fluids solidify in microseconds.



sponse unpredictable. "For all practical purposes, the materials worked but you could never do anything with them," Filisco says. But he recently patented a high-performance "dry" ER fluid that is predictable, responsive, and stable. That development, says Gandhi, was "a prerequisite" for his own work.

Old and New Technology

Many universities and commercial laboratories are experimenting with ways to improve and employ ER fluids. But Thompson and Gandhi believe they were the first to combine them with advanced composite materials and prove that the entire structure could change in response to various excitations. A computer senses these strains and decides which areas need electrical stimulation and how much.

Composites are comprised of two or more materials, with each contributing its own advantages. But standard composites can't adjust to changing conditions, and it is often the unplanned-for scenario that downs a helicopter in the desert, for example. Gandhi and Thompson expect to expand a composite's window of performance and safety by sandwiching ER fluids inside it. This could allow the materials to adjust to a variety of stresses, including vibration and extreme temperatures.

Once ER fluids are practical and their functions understood, Filisco says, the third step is combining them with sensors and computer technology. Such devices detect the stresses and produce electrical fields that stimulate the ER fluids to react. This could "revolutionize" the way machines work—making them "much faster, much more re-

liable, much smaller, and much more diverse without the mechanical parts as we know them."

Gandhi gives an example of how smart materials could improve production. When a rapidly moving robot arm suddenly slows down, residual vibrations can be a problem. In the system Gandhi and Thompson are developing, a sensor alerts a computer of speed changes. The computer instigates an electrical charge that adjusts the stiffness of the arm.

The research has encountered its share of obstacles. Gandhi cites difficulties finding the right ER fluids for each job. For example, some fluids operate in a hydraulic system, while others occur in composite materials. And different concentrations of a fluid affect stiffening properties and response times. Also, the system requires high voltages, and that means adapting equipment to deal with sparks from arcing.

Nevertheless, the MSU researchers have demonstrated that smart materials can respond continuously and immediately to changes in vibrations. They have applied for a patent on a simple mechanical system they developed, and their successes have drawn attention from 200 companies, including aerospace giants like Boeing, Martin Marietta, Lockheed, and Northrop. Gary Anderson, chief of the structures and dynamics branch of the U.S. Army Research Office, adds that smart structures have "a good deal of potential for future military production." His office recently allocated \$1.4 million for research in the field. ■

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Surgery in Space

Suppose a construction worker has an accident on the space station, and there's no doctor in the house. Another astronaut might strap the victim to an operating table and turn on a video link to NASA's Johnson Space Flight Center near Houston. A surgeon at the center wearing a headset that displays the injury in three-dimensional detail dictates the procedure, and the astronaut sutures the wounds. As NASA designs the space station of the 1990s, scientists are creating space-age medical tools to accompany it.

No one *wants* to do surgery in space, however. Magnetic strips or other fasteners must keep instruments and gauze in place, just as the doctor would be tied to the operating table. Administering intravenous solutions is a challenge with no gravity to help liquid flow. And it's hard to keep an operation sanitary when blood and fluids tend to float away.

For such reasons, doctors won't be performing elective surgery or complicated heart-bypasses in orbit, says John Schulz, a flight surgeon at Johnson. An astronaut with appendicitis would slap an ice pack on, take antibiotics, and return to Earth. So far, U.S. space-shuttle crews have made do with drugs and tools in a 10-pound medical kit.

But a space-station assignment might last 180 days. "The space station is the first time we've essentially abandoned people out there," says Schulz. And the astronauts would be assembling the or-



Wearing a headset like this, a surgeon on Earth may someday help astronauts on a space station conduct emergency medical procedures.

biting spacecraft and working in a laboratory, raising the chances for injuries. Scientists packing the space-station clinic must therefore plan for a wide variety of illnesses and accidents—down to calculating the amount of water needed to prepare drugs.

Even if NASA were to fly a doctor on the space station, a network of consulting specialists would be lacking. "They can't just call a radiologist to come in and take a look at the x-ray film," Schulz points out. Since astronauts would have a paramedic's training at best, "our equipment and computer would have to compensate for what they don't know," he says. The astronauts would tie into a network of ground-based consultants, who would turn on computers and view x-rays and diagnostic results transmitted from the station.

Farther into the future, ground-based specialists wearing the NASA headset, now in the prototype stage, could guide astronaut paramedics. Called the virtual environment workstation, the headset is being tested by scientists at NASA's Ames Research Center in Mountain View, Calif., and physicians

at Stanford University Medical Center.

According to Ames research scientist Scott Fisher, doctors wearing the visor will feel as if they are standing in an operating room hundreds of miles away. As they peer through the lenses at two liquid-crystal-display screens, they will have a three-dimensional, stereoscopic, wide-angle view of what is going on. With the helmet blocking out distractions, the scene will appear real, which is why Fisher's group calls it a "virtual environment"—it's virtually real.

Someday, headset users might even "touch" a remote patient with a "dataglove" that receives sensations from

a robot surgeon on the space station. The technology is primitive, but NASA engineers are testing the headset and dataglove on a robot arm that would move spaceship parts. Eventually, "the [human] surgeon wearing the glove will be able to make decisions for the robot such as 'how tight can I pull the skin before it breaks?'" says Fisher.

Before doctors use the headset or glove to direct surgery by robot, many challenges must be met. For example, the devices wouldn't work when the human surgeon was on Earth and the patient on Mars, because it would take too much time for pictures to travel between planets. "You don't

want to go cutting things and wait five minutes to see what the result was," Fisher notes.

Others are skeptical that robots could perform a task as delicate as surgery. "I can't imagine a robot pulling out a gall bladder and handling the many variations of problems I have been through over the years," says William DeCampi, chief resident in cardiovascular surgery at Stanford. An astrophysicist, DeCampi is a member of several NASA life-science advisory committees.

Whether or not the headset flies in space, it could have down-to-earth applications. NASA plans to use virtual environments for flight-simulation training. Fisher also

envisions applying the approach to risky jobs, such as servicing nuclear-plant cores.

NASA is already assisting an effort to train medical students using the headset. "Essentially, it allows you to practice surgery before doing it," says Joseph Rosen, a plastic surgeon at Stanford and the Palo Alto Veterans Administration Hospital. He heads the effort to use the headset as a surgical simulator. Aspiring surgeons could enter a virtual reality: they would operate on virtual patients with virtual scalpels, at worst risking virtual death. ■

ANN GIBBONS is a science writer for the San Diego Tribune.



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Paper Progress

For over a century, chemistry has endangered scholarship. U.S. libraries are filled with books and journals printed on acidic paper that gradually destroys itself. More than 90 million volumes are so brittle that their pages can hardly be turned.

Fortunately, new technology may save endangered books. Moreover, many scholarly books are once more being printed on paper that should rival eighteenth-century handmade sheets for permanence.

The difficulties began in the 1800s, when papermakers began using aluminum-sulfate sizing—soon dubbed “papermakers’ alum”—to give their products printable surfaces and a crisp feel. The sulfate, being acidic, attacks the cellulose fibers, which themselves generate small amounts of acid as they age.

As a result, almost all titles published during the past 150 years are deteriorating in alarming quantities. Richard DeGennaro, director of the New York Public Library, calls it a “national crisis.” He told the Technical Association of the Pulp and Paper Industry that “at least 40 percent of the books in major research collections in the United States will soon be too fragile to handle.”

Careful storage can slow the deterioration. Once-identical 100-year-old books in the New York Public Library and the Royal Library of Holland are now in dramatically different condition. The paper in some New York volumes is “so deteriorated that it crumbles when touched,” according to Richard Smith,

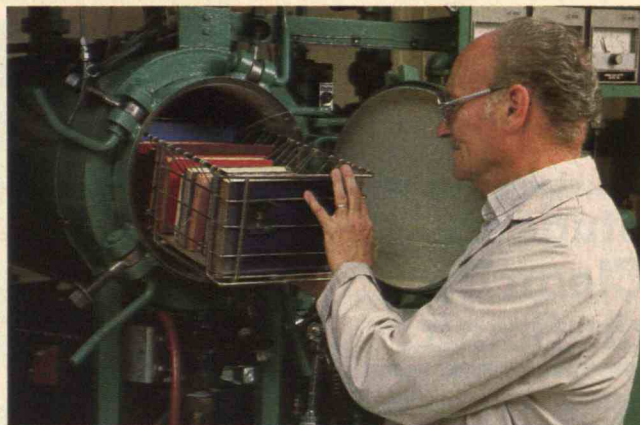
a paper-conservation expert. The Dutch books appear nearly new.

The Dutch have shelved books at temperatures between 60° and 65°F. Only in 1986 did the New York library air-condition its stacks. Until then, the temperature was never less than 70°, says John Baker, the library’s preservation and conservation chief, and the books were often bathed in pollutants that came in through open windows.

While better storage can help, several technologies under development could halt acid attacks entirely. As a University of Chicago graduate student, Smith devised a way to remove acid from paper. He vacuum-dries books, then floods them with a magnesium compound that neutralizes the acid. The treatment poses little risk to ink and bindings. Smith’s Wei T’o Associates has developed pilot plants in Canada and France that can treat 100 books an hour.

A similar process called Bookkeeper immerses books in inert Freon for 30 seconds. Tiny acid-attacking magnesium-oxide particles are suspended in the Freon so that when it is drained away, the books are deacidified. The University of California at Berkeley has tested the process successfully and is discussing a prototype machine that could treat about 50,000 books a year.

The Library of Congress is pursuing a more exotic technology that bathes books in diethylzinc (DEZ) gas for six to eight hours. The zinc neutralizes acids during the bath, and some of it remains to protect the paper from acids that appear later. The Library of Congress’s pilot plant—the culmination of 14 years of research—can deacidify 600 to



1,000 books a week. A full-scale plant could handle over 1 million books a year for less than \$2 each.

However, DEZ ignites spontaneously in air or water, making the process hard to engineer and expensive to use. Moreover, according to the Office of Technology Assessment, the approach is not proven: “It is not clear how long the life of an actual book will be extended.”

A Basic Solution

Harvard University book preservationist Lofton Wilson has concluded that microfilming is “the only technology right now that seems feasible” to save endangered books. But for avoiding deterioration, the necessary technological breakthrough came nearly 40 years ago when Hercules Powder Co. developed synthetic sizing agents that work in alkaline solutions. Paper that has good printing and handling qualities can thus be made without the acidity of papermakers’ alum.

According to *Alkaline Paper Advocate*, printers and readers can’t tell the difference between such “permanent” papers and conventional ones. And a recent survey for the National Library of Medicine found that prices are comparable. Furthermore, alkaline papermaking requires less fiber and water, yields wastes that are less polluting, results in paper that is whiter and stronger, and re-

The National Archives of Canada treats books with a magnesium compound. This removes acid from the paper, stopping deterioration.

duces corrosion in papermaking machinery.

Advocate editor Ellen McCrady says that converting a mill to non-acid production can be done in less than 12 hours after suitable preparation. Papermakers can recoup their investment in less than three years through reduced water and fiber consumption and waste treatment. But McCrady admits that there is potential for serious technical problems because papermaking is “still an art, not a technology.”

Under pressure from librarians and conservators, the reluctance of the paper industry to invest in alkaline papermaking is gradually giving way. Pressed by water shortages, the P.H. Glatfelter Co. began the trend by converting its mill in Spring Grove, Pa., to acid-free production in 1974. Some 25 manufacturers now offer alkaline book papers, and publishers are responding. Nearly 60 percent of U.S. university presses now demand alkaline paper; another 15 percent use acid paper only in paperbacks. And Random House and Simon & Schuster specify acid-free paper for first printings of all hardbound books. ■

JOHN MATTILL is editor emeritus of *Technology Review*.

Students Clean Up the South

In the summer of 1988, Vanderbilt University student interns promoted a community recycling program in Zip City, Ala., studied pollution problems of towns in southern Louisiana, assisted with safely closing a Nashville municipal landfill, and helped monitor a toxic-waste dump in Emelle, Ala., the nation's largest.

Every summer, 80 to 100 people from around the country apply for 12 to 15 slots in the Nashville University's Student Environmental Health Project (STEHP). Interns usually work in small Southern towns, assisting tiny community organizations with minuscule budgets. In the real-life laboratory of the rural South, the students learn how science policy affects citizens.

They also learn a bit about Southern life. "I spent a lot of time on front porches," says Mike Williams, a student from the University of California at Davis. He devoted last summer to working in Emelle for Alabamians for a Clean Environment, "talking about the weather and gardening—and some about toxic wastes."

STEHP has aided the citizens of Central City, Ky., as well. Dora Mercer raises beef cattle there, and she says, "I've lost 15 of them. . . . Some were born all deformed—without eyeballs or with big knots on their joints." She felt the cause was pollution in the Mud River, the farm's only source of water. In 1985, a Rockwell In-



In the summer of 1987, Hallie Cooke tested water from Kentucky's Mud River as part of an innovative project at Vanderbilt University.

ternational plant in Russellville, Ky., had spilled large quantities of PCBs into the river.

Mercer and her neighbors formed the Concerned Citizens of the Mud and Green [Rivers] Project, and in the fall of 1986, they sent water samples to STEHP's screening lab for soil and water testing. The lab charges only a few dollars per test, just enough to cover the cost of consumable materials. The next year, two STEHP students went to the area, where they collected more water samples and conducted a community health survey. As a result of STEHP's preliminary investigations, state environmental officials conducted further tests and found severe levels of PCB contamination. Warning signs are now posted all along the river.

STEHP provides similar assistance to dozens of organizations throughout the South, according to Pam Stone, who co-directs the program with Maria Schutt. In addition to running the screening lab and recruiting summer interns, STEHP serves as a year-round clearinghouse and resource center on environmental questions. The program is part of Vanderbilt's Center for Health Services, the umbrella for a number of com-

munity outreach programs.

In addition to Stone and Schutt, STEHP's environmental testing lab is staffed by a full-time coordinator as well as several graduate and undergraduate students. The equipment includes a gas chromatograph, ultraviolet spectrometer, and atomic absorption spectrophotometer. However, STEHP can't afford the equipment and personnel to gain certification from the U.S. Environmental Protection Agency (EPA), so the lab's results can't be used in court.

"We're a screening lab, a preliminary reconnaissance facility," says Vanderbilt chemist David Wilson, faculty advisor for the lab. He points out that STEHP enables groups to get the most out of scarce resources. Because STEHP is "a heck of a lot cheaper" than EPA-certified commercial labs, "we can look at maybe 50 samples for a low cost" and eliminate 48, Wilson notes. Then the community group can raise money to test the remaining 2 samples fully.

The STEHP lab helped the Caldwell County Concerned Citizens convince North Carolina to close a toxic-waste incinerator, says member L.C. Coonts. He thinks the incinerator was contaminating

livestock and making people ill. Water and soil test results from Vanderbilt provided the information necessary to conduct more detailed chemical analysis, explains Coonts, who is a high school chemistry teacher. That prompted the state government to act.

Because STEHP handles complicated environmental questions, it is often controversial. The program reports to Vanderbilt's associate vice-chancellor for health affairs, Eugene Fowinkle, who also dealt with STEHP firsthand as Tennessee commissioner of health from 1969 to 1983. Fowinkle recalls, "They were always providing a voice and a factor on the side opposite an industrial vested interest."

Fowinkle believes that Vanderbilt administrators aren't concerned about occasional complaints from attorneys representing companies targeted by STEHP. And commenting on what he sees as the students' tendency to be overzealous at times, Fowinkle says, "I want them to be right, and go after those who are not following the rules." He adds, "There are plenty of them. There are still midnight dumpers, still industries who cheat."

Perhaps the extent of violations explains why the STEHP model is spreading. In 1985, a student from Vanderbilt started a similar program at Virginia Polytechnic Institute-State University to use academic scientific resources to serve communities. And the next year, a graduate of that project started one at Colorado State University. ■

ROGER KERSON is a free-lance writer based in Chicago.



COMPUTER EXPORT

Export controls on personal computers, semiconductor chips, and many other computer components are virtually unenforceable because of smaller sizes, rapid technological advances, and high-volume production, says a National Research Council (NRC) committee. Professional workstations and other small computers are easy to hide and transport, and software is "inherently easy to acquire," the committee notes. Furthermore, computer networks can readily transmit information about both hardware and software.

The NRC called for more flexible controls but also recommended strong protections for critical defense technologies, including high-performance computers and top-of-the-line manufacturing systems.

SAFETY BELTS

In the three years after Michigan's safety-belt law went into effect in 1985, hospital stays of a week or more that result from a car crash plummeted 43 percent. According to University of Michigan transportation scientist Alexander Wagenaar, "there also has been a 19 percent reduction in the number of car crash victims admitted to hospitals and a 20 percent reduction in the rate of crash victims admitted with injured arms and legs." Fatalities have dropped 19.7 percent.

Researchers have observed more than 205,000 people throughout Michigan to determine the use of safety belts. The teams have collected data on 8,661 patients at 14 hospitals as well. Thoracic injuries are the only kind that haven't decreased.

PROTON THERAPY

Fermi National Accelerator Laboratory at Batavia, Ill., has inaugurated the first proton-therapy accelerator. It treats rare cancers with a beam of protons that eradicates malignant cells. The narrow focus of the beam limits radiation doses to a disease site, reducing side effects.

No patients will be treated at Fermilab. This summer, technicians will disassemble the device and move it to Loma Linda University Medical Center in California.

About 20 feet in diameter, the accelerator is the world's smallest proton synchrotron. It will deliver 70 million to 250 million electron volts of energy. Fermilab's Tevatron—the world's largest—is four miles around and delivers 1 trillion electron volts.

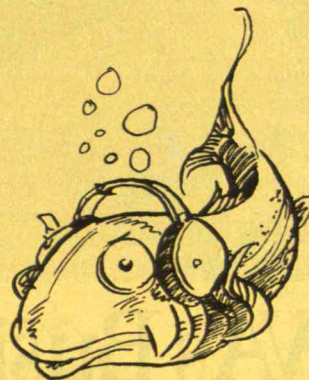
MAGNETIC TRAINS

West Berliners will soon ride a mile-long magnetic railway, perhaps the world's most advanced local traffic system. Despite its cost of about \$80 million, many cities and businesses have expressed an interest in the system. The major attraction is the light

weight of magnetic trains, which yields energy savings of up to 40 percent and reduces the expenses of laying track. At 9.5 tons, the Berlin railway car weighs half as much as a regular subway car.



Because this magnetic train operates automatically, cars can follow one another at one-minute intervals, eliminating waiting time without sacrificing safety. Moreover, it works almost silently: the first successor to the Berlin train will be in Las Vegas, where it will run through a library building.



NOISE POLLUTION

Noise from humans may damage the health and change the behavior of fish and marine mammals. Citing a number of studies, University of Miami marine biologist Arthur Myrberg, Jr., says, "The deleterious effects ... can no longer be questioned."

In the Beaufort Sea, scientists observed about 120 bowhead whales, a species that is almost extinct. All these whales stayed over six miles from a drill ship, "even though it was on their direct migrating path," Myrberg reports. Beluga whales emit "easily recognized alarm calls" when large ice-breakers are 50 miles away. And geologists who have set off dynamite in Antarctica to profile ocean sediments have damaged the inner ears of seals in the Weddell Sea.

Noise may also affect fish grown for food. One study indicates that for two species loud sound harms eggs and slows the growth of offspring.

MEN AND WOMEN

Gender differences in spatial and mathematical ability have declined almost to zero, says a researcher at the University of California at Berkeley. Paralleling reports last year that the verbal abilities of men and women are converging, the findings suggest that gender differences in all cognitive abilities are disappearing.

According to Marcia Linn, adjunct professor in the Graduate School of Education, women's lower spatial and mathematical ability has often been used to explain men's greater access to scientific fields, higher income, and better math scores on the Scholastic Aptitude Test (SAT).

However, the gaps in SAT scores, occupation, and income remain, even though gender differences in ability have narrowed, Linn observes.

DNA PICTURES

Scientists from Lawrence Livermore National Laboratory and Lawrence Berkeley Laboratory have produced the first direct images of the double helix in unaltered DNA. The three-dimensional images, magnified 1 million times, reveal DNA's structural features in unprecedented detail.

The team made the images with a scanning tunneling microscope, a device that can record the surface details of single atoms. When the microscope's sharp-tipped stylus comes within a few angstroms of a sample's surface, a current of electrons crosses the gap via a phenomenon known as tunneling. The stylus keeps the current constant by moving up and down over the atoms, and a computer translates this motion into an image.



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Who Innovates?

In public policy, as in fashion, styles come and go. For the past decade, many economists have promoted the view that dynamic, entrepreneurial small firms are the engine of technological innovation and economic growth.

No doubt, this tenet's popularity has been partly due to the way it has so perfectly matched the tenor of the times. But as the individualist, free-market Reagan era begins to fade, and the nation is forced to cope with looming deficits and tough international competition, a new breed of revisionists is questioning the presumption that "small is efficient."

Celebrating Small Business

The recent celebration of the small firm was a reaction to earlier trends in economic thinking. In the 1950s and 1960s, prominent economists emphasized the economic power and efficiency of the large corporation. For example, John Kenneth Galbraith argued persuasively that the American economy had become driven by large corporations possessing market power and the capacity to engage in long-range planning. Business historian Alfred Chandler showed that the centralized structure of firms such as General Motors gave them the ability to "command and control"—rather than passively react—to their environment.

But as the U.S. economy began to struggle with the unfamiliar problems of stagflation, keener international competition, and the decline of traditional manufacturing industries, the central importance of the large firm was challenged.

Probably no one has had more practical impact in drawing attention to the role of small firms than MIT researcher David Birch. Using Dun and Bradstreet data on business births, deaths, expansions, and contractions, Birch has argued that between 1981 and 1985, firms with fewer than 20 employees were responsible for creating 88 percent of all new jobs. As a consultant to dozens of governments here and abroad, Birch has preached the gospel that small rather than large companies are most responsible for the dynamism of national as well as regional economies.



The role of small firms in adopting new technologies and creating jobs has been greatly exaggerated.

In 1984, MIT professors Michael Piore and Charles Sabel theorized that small firms are especially well suited to "flexible specialization"—combining high technology with skilled workers to produce a wide variety of products. Such firms solve the problems of globally fragmented markets and chronic excess capacity—problems not anticipated by Galbraith or Chandler—by making small batches of a particular design and then quickly shifting to another as demand changes. Many of these firms have also learned to develop new process technologies and specialized equipment. Networks of such small firms have a good chance of becoming the dominant form of industrial organization, according to Piore and Sabel.

Conservative economist George Gilder has latched onto the idea that small firms are the key to innovation to argue against a national industrial policy. The key to U.S. economic strength, claims Gilder, is the success of high-tech industries in international markets. And high-tech sectors in both the United States and Japan (according to Gilder) are

driven by the smallest, most entrepreneurial firms. His moral: support the free market, and especially avoid regulation that might suppress the creativity of these vigorous entrepreneurs. As for industrial policy: forget it. Big government and big business are equally irrelevant to national competitiveness.

The New Revisionists

The popularity of such views virtually guaranteed that they would not go unchallenged for long. The past year has brought a new crop of revisionists whose common message is that the demise of the big firm is greatly exaggerated.

First, the accuracy of David Birch's findings, on which so much of the celebration of small firms is based, has been challenged. Using the same Dun and Bradstreet data, the U.S. Small Business Administration estimates that between 1982 and 1986, only 36.5 percent of new private-sector jobs were created by firms with 20 employees or less—a share far below Birch's 88 percent figure.

A recent study by Carnegie-Mellon's Maryellen Kelley and Harvard's Harvey Brooks has also shown that as a description of what is going on in the U.S. economy, Piore and Sabel's "flexible specialization" thesis contains a major flaw. Kelley and Brooks found that U.S. plants that have adopted programmable automation—the quintessential flexible technology—are most likely to be large plants of major corporations, not small plants in small companies.

Finally, as MIT researcher Charles Ferguson's work on the U.S. semiconductor industry has pointed out, the visions of people like Gilder are pure fantasy. In both the United States and Japan, crucial high-tech industries continue to be dominated by large firms who maintain their flexibility by forging powerful alliances with each other and, when necessary, even their foreign competitors.

More importantly, some economists now say, the preoccupation with firm size has obscured a more central issue—how companies of whatever scope organize themselves to become more technologically proficient. How does innovation spread throughout a firm? What are the company's links to other organizations, especially the small suppliers on which local economies are often based?

In a synthesis of the best of the ideas developed over the past two decades, state and local governments are relying on the public-private partnerships championed by Piore

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BENNETT HARRISON is a professor in MIT's Department of Urban Studies and Planning. His latest book, co-authored with Barry Bluestone, is *The Great U-Turn: Corporate Restructuring and the Polarizing of America*.

Things They Never Teach You in Engineering School

Engineers like to see themselves as rational, no-nonsense individuals who spend their time devising clear-cut solutions to complex technical problems. It's an attitude encouraged in engineering school, where no matter how furious the disagreements over the elegance or economy of a particular design, there is always a professor to step in with the "right" answer. This breeds the assumption that with the proper competence and enough experience, you can arrive at the best solution to any technical problem—an answer with which other engineers will agree.

But after 40 years as a practicing engineer, I've come to see things differently. Contrary to popular perception and the assumptions of my school days, the practice of engineering is often frustrating and farcical, disconcerting and droll, filled with petty squabbles and ideological debates.

Entrepreneurs and corporations compete among themselves and often enter into contractual relationships that require mutual scrutiny. These producers, in turn, are constrained by public agencies and interest groups. Since engineers play a variety of roles in all these organizations, professional disagreements are bound to occur. Moreover, engineers being human, their approach to technical problems can be dramatically affected by personal idiosyncrasies. This is by and large healthy for the body social, but often bothersome to the individual practitioner.

Of Bricks and Bibles

As a civil engineer working in the construction industry, my assignment is to construct a building and do it efficiently and economically. From this perspective, excessive caution—wasting time and money for no good reason—is simply bad engineering. But I've come to realize that not all the many engineers I deal with see it that way, none less so than the building inspector.

Inspectors are charged with verifying that my company has complied with plans and specifications. Their role is to view me with suspicion. And of course, I have come to consider some of them obstructionists, fools, petty tyrants, and worse. We have an adversarial relationship that occasionally can rival



*Engineering
is rarely the clear-cut,
scientific practice
most students
expect.*

that of prosecutors and defense attorneys.

When we clash, it is rarely over engineering theory or even issues of public safety. Our arguments are invariably about what constitutes a reasonable interpretation of the contract documents: What deviation from perfection is permissible? How level is level? How smooth is smooth?

On one of my first jobs, there arose a problem so bizarre it would have been laughable, except that it was deadly serious and involved a potentially large loss for my employer. We were putting the finishing touches on a five-story masonry building when the Owner's project inspector summarily ordered us to remove large portions of the front facade. Some of the bricks were excessively dark, he explained, a sign that they had been overburned in the kiln. Not only was the color range unacceptable; he feared that the overburning had affected the strength and porosity of the brick, making it liable to disintegrate or absorb water.

In the ensuing imbroglia, many more en-

gineering personalities appeared on the scene: the engineer who had designed the structure under contract with the architect, two chemical engineers (one working for the brick manufacturer, the other representing the manufacturer's trade association), engineers from the testing laboratories brought in by both sides of the dispute, and, by implication if not their actual presence, the many engineers who had developed the standards in the contract specifications.

Eventually all parties concluded that the installation was safe, durable, and watertight. But the inspector still wasn't satisfied; there remained the issue of permissible variation. He argued that if the bricks were accepted, the contractor would "get away" with something. At the very least, some penalty ought to be assessed. The matter was referred to the Owner.

In this case, the Owner happened to be the Catholic Archdiocese of New York, and, appropriately enough, the person designated to rule on our appeal was a priest. I will never forget the occasion. The hearing took place in a splendidly decorated ecclesiastical chamber, and the decision was rendered in the form of a sermon. The lesson of the day, complete with biblical references, was that in the nature of things, bricks should be expected to come out of the kiln with slight variations. The inspector was looking for a degree of perfection found only in heaven.

Master of the Building Code

More recently, our company was nearing completion of a residence for the indigent elderly. We were in the process of obtaining a certificate of occupancy when an inspector for the supervising government agency informed us that the community room did not have enough ventilation. The building code required that window openings had to equal at least 5 percent of the room's floor area. We had calculated that the 8-foot square windows we had installed met the 5 percent rule, but the inspector informed us we were mistaken. Because the window had a solid two-inch metal frame, the clear area when it was open was in fact only 7 feet, 8 inches square. Thus, we were slightly out of compliance.

The consulting engineer who had designed the building's mechanical systems reviewed his calculations and concluded that there was more than enough fresh air. But the inspector stood firm on his literal interpretation of the code, even in the face of

Continued on page 77



SAMUEL C. FLORMAN, a civil engineer, is the author of *Engineering and the Liberal Arts*, *The Existential Pleasures of Engineering*, *Blaming Technology*, and *The Civilized Engineer*.

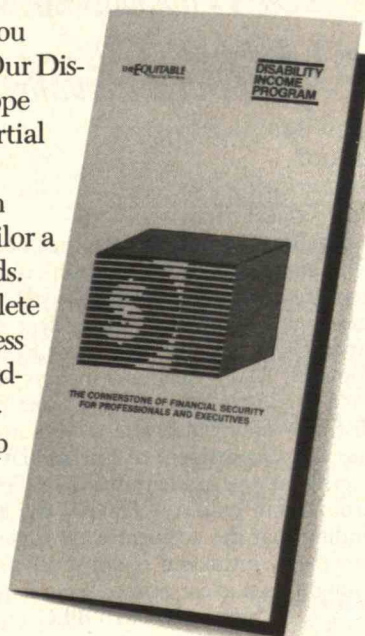
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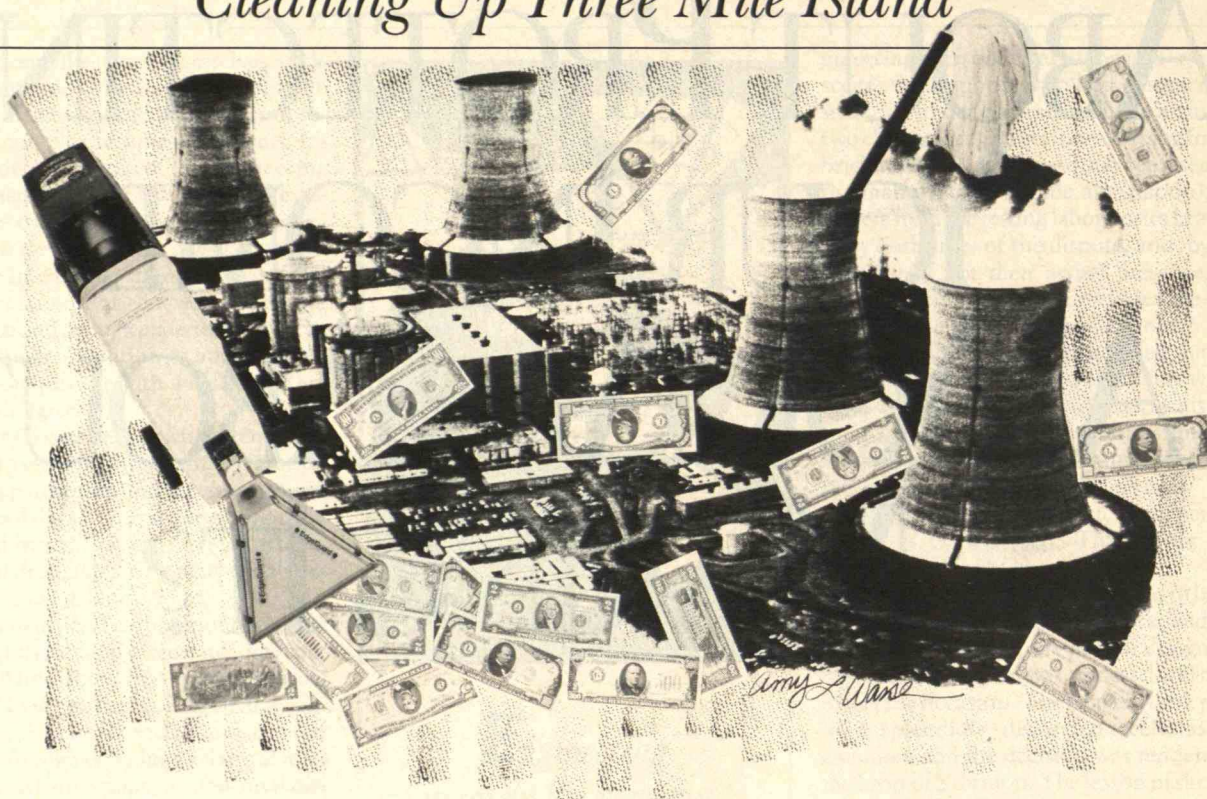
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BY ANN MARIE CUNNINGHAM

Ten Years After: Cleaning Up Three Mile Island



ON March 30, 1979, Unit 2 of the Three Mile Island nuclear power plant near Harrisburg, Pa., appeared close to a meltdown. But after Walter Cronkite implied that to his CBS Evening News audience on the third day of the accident, the Nuclear Regulatory Commission, the responsible utility, local residents, and even federal investigators accused him of exaggerating. Now, 10 years later, experts have shown that Cronkite was correct. In fact, no one can say now why the outer wall held, keeping liquid radioactive fuel from escaping.

The tenth anniversary of Three Mile Island (TMI) is nothing to celebrate. Clearly the plant will never reopen. Engineers expect to finish the \$973 million cleanup by the end of this year, according to Doug Bedell, spokesperson for GPU Nuclear, which operates Three Mile Island for its parent company GPU. Even though the price is seven times the estimate given right after the accident, questions remain about the adequacy of the cleanup measures.

ANN MARIE CUNNINGHAM, a freelance writer, was on the staff of the President's Commission on the Accident at Three Mile Island and co-authored the report of its Task Force on the Public's Right to Information.

*As the mop-up
nears an end,
fear and uncertainty
linger.*

The consequences of the accident extend beyond TMI. The cleanup's duration and price are major reasons why U.S. utilities haven't ordered any nuclear plants since 1979. And problems that have surrounded TMI's cleanup—such as higher-than-originally-expected costs and public distrust—could also affect cleanups that the U.S. Department of Energy (DOE) is facing at its nuclear-weapons plants around the country. Finally, the recent finding that the accident was worse than previously estimated is not a comforting thought as nuclear power again is touted as a sane alternative to OPEC and the greenhouse problem.

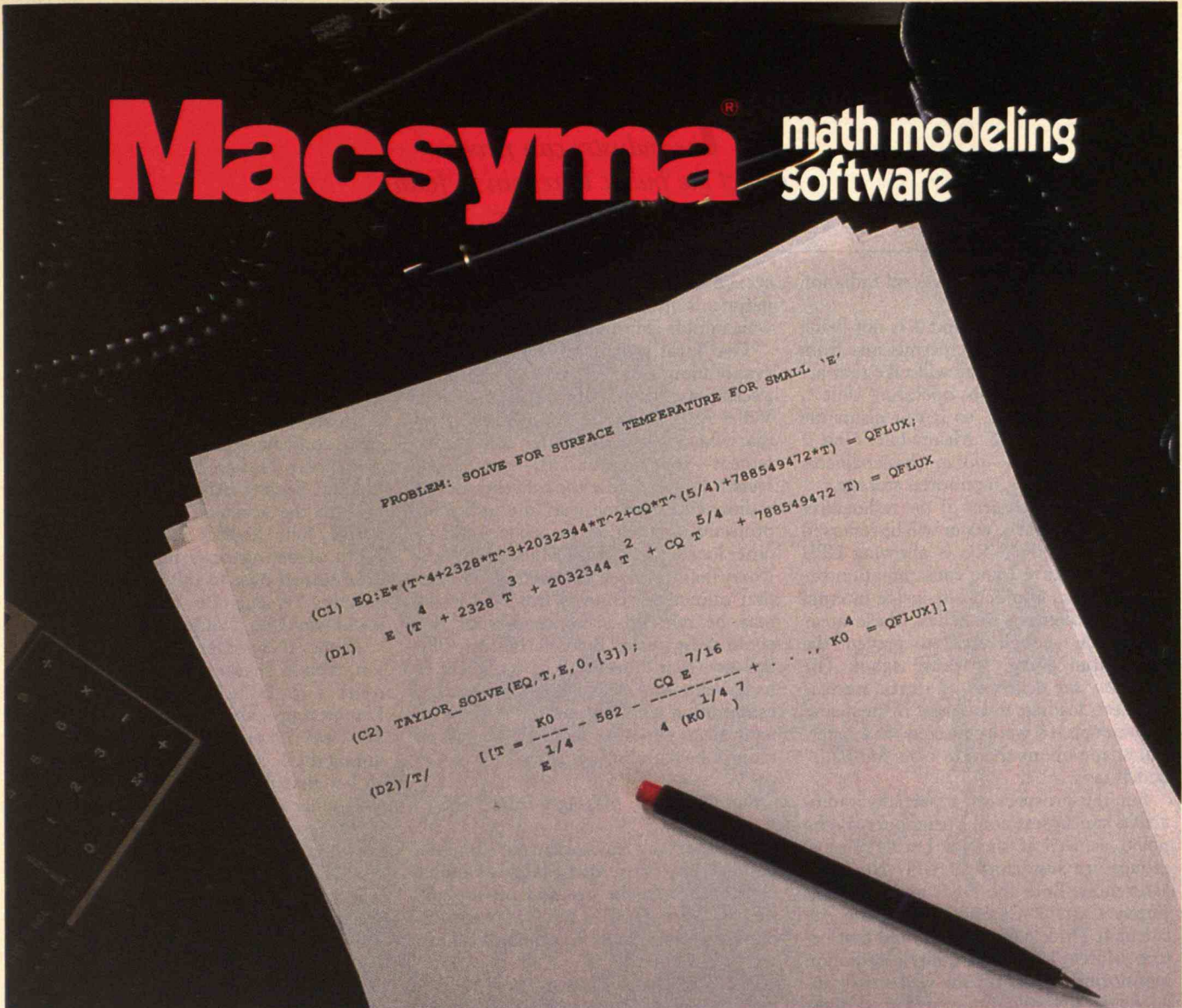
At Three Mile Island, the utility and its customers are paying a third of the cleanup bill, with GPU's private insurers

picking up another third. The rest of the money is coming from four groups. One is DOE. Two others are the states of Pennsylvania and New Jersey—which, as the sites of GPU subsidiaries, had been allowed to tax TMI's electricity sales. Finally, the Japanese nuclear industry is contributing \$18 million in exchange for technical information gathered during the cleanup.

In addition to the direct cleanup charges, Three Mile Island will cost DOE almost \$20 million, the price of storing 150 tons of radioactive debris from the accident for the next three decades. Almost all of the 100 tons that have been removed from the plant site so far have been shipped to DOE's Idaho National Engineering Laboratory, where they await transfer to the new federal repository for spent fuel at Yucca Mountain, Nev. At best, that site won't be ready until well into the next century.

GPU Nuclear's Bedell says that the Nuclear Regulatory Commission (NRC) appears to be aiming for an "unrestricted" clean site when TMI is decommissioned—when the remaining plant itself is dismantled. But the only decommissioning ever undertaken in the world—at the nearby Shippingport, Pa., experimental nuclear

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*The industry can never
expect the public to regain its faith
in nuclear power.*

plant—did leave some low-level radiation behind.

Moreover, for now Unit 2 is not being decommissioned. With permission from the NRC, GPU Nuclear will take that action only when it stops operating Unit 1, perhaps in 30 years, so it can dismantle both plants at once. Meanwhile, Unit 2 will be mothballed—put in what engineers call post-defueling monitored storage.

Although 99 percent of the radioactive rubble and all of the water will be removed in this stage, the NRC is allowing GPU Nuclear to leave some contamination behind, such as film deposits inside internal piping. According to Bedell, these areas will be far enough apart to prevent the plant from going “critical” again. The only way the debris could start a nuclear reaction, leading to a surge of heat and radiation, is if it were collected “in a spherical shape about the size of a football,” Bedell says.

But the prospect of a partially radioactive site upsets some neighbors of the plant, as well it should. Local citizens’ groups are suspicious of GPU Nuclear’s assurances. Both the NRC and President Jimmy Carter’s Commission on the Accident at Three Mile Island found that before March 1979, the utility’s radiation monitoring on and off site was grossly inadequate. Investigators were forced to estimate radiation releases and exposure to local residents. Since then, GPU Nuclear has beefed up its system, but now is considering reducing its monitoring.

In contemplating the move, GPU Nuclear is taking a cue from the U.S. Environmental Protection Agency (EPA). EPA is phasing out its own efforts at monitoring air and water radiation around the site, claiming that its mandate from President Carter was to measure releases only during the cleanup. Although Pennsylvania is gradually assuming responsibility for radiation monitoring, residents worry about EPA’s phase-out. No one knows whether the state will maintain the same level of oversight. Two separate scientific studies sponsored by the Three Mile Island Public Health Fund—a public-interest group set up by the courts—recommended increased monitoring with updated equipment.

Another concern is that GPU Nuclear wants to dispose of radioactive water that has sat in the reactor vessel since the accident—as well as water from the cleanup—using a \$7 million decontamination and evaporation procedure. The

system is now being tested, but full experiments using radioactive water must wait until it is installed at the plant site.

Two local groups are arguing against evaporation. According to Louis Kosarek, a scientific consultant for the Susquehanna Valley Alliance, the NRC’s own tests show that when radioactive water contains detergent—as it does at TMI—the cleanup system cannot reduce the concentration of radionuclides to the level the utility has projected. In addition, the alliance and another local group, Three Mile Island Alert, worry that tritium, a radioactive substance that cannot be removed from the water, may be released in concentrations that could cause cancer. But GPU Nuclear’s Bedell says that “there will be no health effects—exposure over the entire period of evaporation will be about the same as the equivalent exposure from two hours of natural background radiation.”

Other Cleanups: Messages from TMI

Of course, any environmental contamination from Three Mile Island is minimal compared with the on- and off-site pollution from DOE’s nuclear-weapons plants in Ohio, South Carolina, Washington, and Colorado.

Although the cleanup at Three Mile Island is very different from those needed at the weapons plants, the fact that GPU, overseen by the Nuclear Regulatory Commission, originally underestimated TMI’s cleanup costs significantly is a worrisome reminder about difficulties in predicting such costs accurately. While DOE has previously estimated that the weapons-plants cleanups will run between \$53 billion and \$200 billion over 60 years, the agency now puts the figure at no more than \$92 billion. Senator John Glenn (D-Ohio) believes that the \$200 billion price tag is much more accurate.

The TMI cleanup also sends another clear message about similar situations: we cannot expect the problem of radioactive waste disposal to disappear anytime soon. As at TMI, the only possible solution for cleaning the waste from the weapons plants is to move the material somewhere else. Exactly where is unclear. The National Engineering Lab in Idaho accepted TMI’s waste only because it was interested in using some for research.

Finally, because NRC is allowing Three Mile Island to be mothballed for 30 years, communities near the weapons plants may

fear that DOE’s approach to cleanup will be similar.

Besides highlighting the cleanup difficulties associated with the long-ignored nuclear-waste problem, Three Mile Island is showing experts how much there is to learn about what can happen during a nuclear accident. Research has been extensive: last November, the American Nuclear Society (ANS) devoted a conference to the accident, and NRC spokesperson John Kopeck says that an entire room of the agency’s public library has been turned over to the massive TMI literature. Yet engineers still don’t understand why Unit 2 didn’t melt down.

At the ANS conference, James Broughton, then in charge of analyzing the accident for DOE’s Idaho National Engineering Laboratory, estimated that “at least 50 percent of the core melted during the accident.” The molten fuel was so hot that it burned through a double-steel inner wall of the reactor’s containment vessel. The unsolved mystery is why the outer wall did not rupture, allowing a breach of radioactive fuel.

Some answers may follow after engineers remove the last three tons of radioactive debris at the bottom of the reactor vessel, probably by the end of this year. But DOE and the NRC expect they will need two more years of analysis to get a definitive picture of what happened during the accident.

So far, a good deal of guesswork has gone into some of the research. According to Franklin R. Standerfer, who in 1988 directed the plant cleanup for GPU, even the most up-to-date figures on the amount of melted core are simply estimates.

Since what happened during the accident is fuzzy even after 10 years of study, the public is justified in thinking that other unexpected problems could occur in nuclear plants. The industry can never expect the public to regain the faith it had in nuclear power before the Three Mile Island disaster.

As the Soviets offer us new reactors to power space satellites, and as researchers tout smaller, cheaper, “fail-safe” reactors, the public should respond with caution. We’ve heard assurances before. Three Mile Island was the accident that the nuclear industry said would never happen. Ten years later, the one thing that’s clear, as an NRC staffer exclaimed at the time, is that the accident was “a serious, serious damn event.” ■



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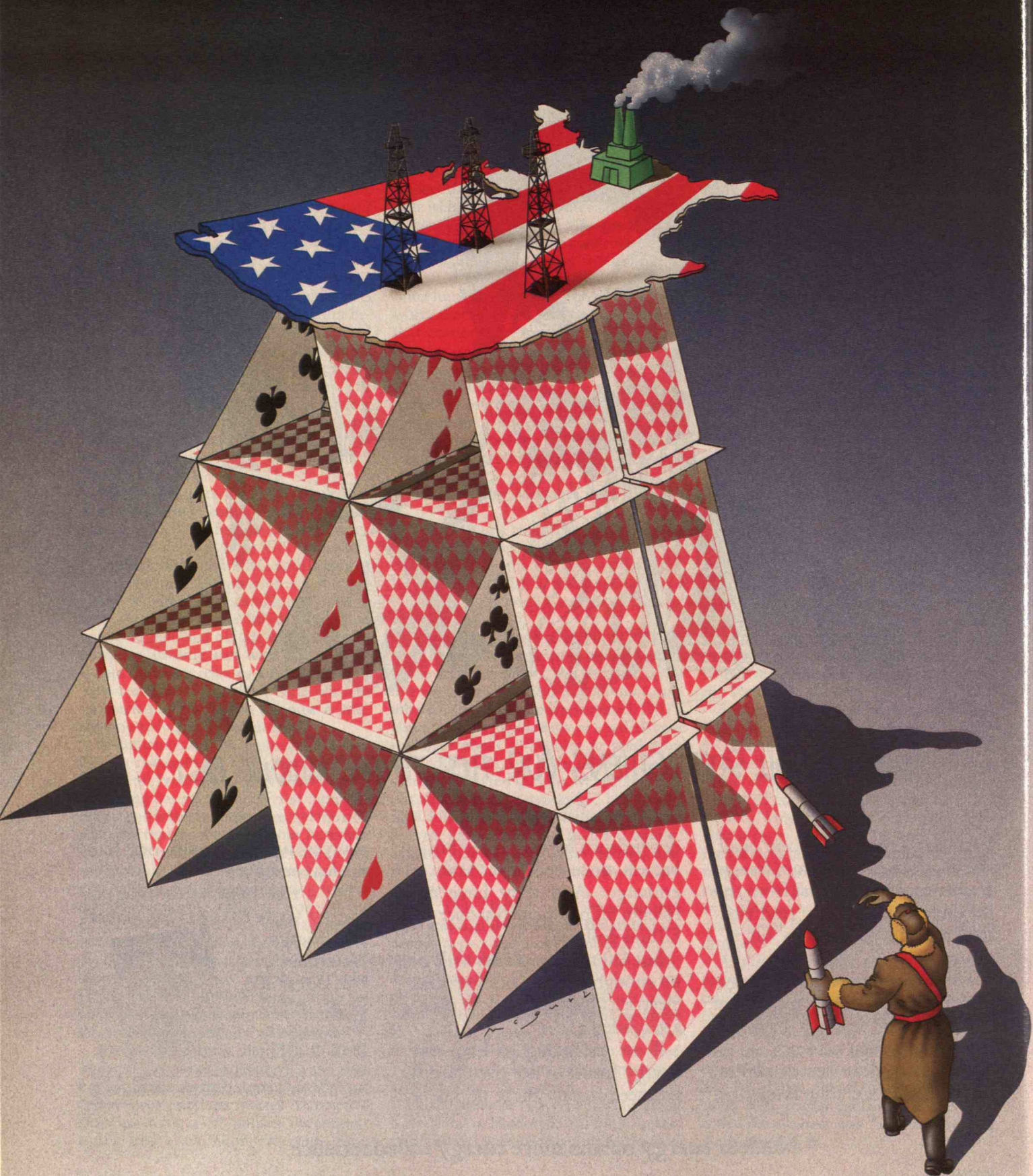
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Can the U.S. Economy Survive A Few Nuclear Weapons?

BY M. ANJALI SASTRY, JOSEPH J. ROMM, AND KOSTA TSIPIS

A small nuclear attack might kill "only" 10 percent of the U.S. population outright, but the economy could soon collapse, causing half the survivors to die from starvation.

WHETHER George Bush and Mikhail Gorbachev are able to negotiate large cuts in strategic arms may hinge on beliefs about the potency of reduced arsenals. Could an industrialized society survive an attack by a few hundred nuclear weapons — a small percentage of the roughly 10,000 each side now holds?

If a small nuclear strike could devastate the U.S. or Soviet economy and society, strategists cannot plausibly argue that thousands of nuclear explosives are needed to provide a deterrent — the ability to launch a devastating counterattack. Nor could planners reasonably expect to fight and win a nuclear war, since such a scenario also posits that a modern economy could withstand attack by a significant percentage of the other side's weapons.

The U.S. economy could revert to the manual labor characteristic of the Middle Ages.

A great deal therefore rests on the question of whether the United States or the Soviet Union could survive 1 to 2 percent of the opponent's current arsenal. Despite perhaps 20 million deaths, the burden of caring for the injured, and the enormous destruction, would the fabric of society hold?

Nuclear war-fighting plans usually emphasize attacks on key industries. To inflict maximum economic damage, the Soviet Union would target U.S. facilities that refine, store, and transport liquid fuels, including all commercial ports, major pipelines, and the Strategic Petroleum Reserve. According to 1986 figures, 98 percent of the fuel used in transportation is derived from petroleum. Destruction of oil facilities would halt nationwide transportation for a period as short as several months or as long as several years.

What would happen to the U.S. economy if transportation collapsed, even temporarily? To explore this question, we turned to a 1980 computer model commissioned by the U.S. Federal Emergency Management Agency (FEMA) to examine the U.S. economic fate after a nuclear attack.

To err on the side of caution, we made optimistic assumptions about the effects of the attack. First, we considered only the damage caused by heat and blast from the explosions. We hypothesized that injuries would be caused by direct burns but not by radioactive fallout, that dust and soot from the blast would not produce even a mild "nuclear winter," and that electromagnetic pulses from explosions would not harm communications networks.

We considered many possibilities for factors such as the rate of food and fuel imports, the speed with which transportation could be restored, and the morale of the population. In our optimistic "baseline" case, we assumed that there were few injured people to care for and survivors did not suffer psychological problems. People were therefore able to work at rebuilding key industries. Lack of transportation would cease to be a bottleneck after only 18 months. Despite destruction of all commercial ports, most imports would continue at 20 percent, and petro-

leum imports at 10 percent, of previous levels the first year after the attack. We assumed that all imports would increase in later years.

The results of the different scenarios were sobering. In the baseline case, while an attack targeted on liquid-fuel facilities would kill "only" 10 percent of the population outright, it would lead to shortages of energy, transportation, and food that could cause mass starvation and economic collapse over the next two or three years. Society as we know it might not survive.

Petroleum: The Crucial Link

In studying a small nuclear attack, we posited that the Soviets would launch 85 weapons of 550 kilotons and 154 weapons of 200 kilotons—for a total of 239 warheads. The USSR might also target about two dozen weapons on Canada and Mexico to prevent them from providing aid. The full attack would represent between 1 and 2 percent of the total destructive energy of the Soviet nuclear arsenal.

Even in this small attack directed at the U.S. economy, most major U.S. cities would receive one or more nuclear weapons. We assumed that within the zone where a weapon would exert a pressure of 5 pounds per square inch (psi)—a 3.5-mile radius for a 550-kiloton bomb—all buildings would be destroyed and everyone killed. Outside this area, we assumed no destruction of buildings. This is an underestimate given that fires would ravage an area almost twice that size. In areas where the blast would deposit 10 or more calories of heat per square centimeter—a radius of from 3.5 to 5.5 miles—we assumed that half the population would be killed and half injured. We factored in no damage or injuries beyond that distance and, as mentioned, no effects from radiation, electromagnetic pulses, or soot deposited in the atmosphere by fires.

In all, about 20 million Americans would die and 5 million would be injured—casualties totaling 10 percent of the population. The U.S. economy would lose just 8 percent of its total manufacturing capacity. Yet many industrial installations near petroleum facilities would be wiped out, including 25 percent of primary steel manufacturing capacity and 18 percent of primary nonferrous metals manufacturing.

The damage would devastate the entire energy sector. Almost every active and inactive U.S. refinery, as well as the Strategic Petroleum Reserve, would be destroyed. The attack would also target the nation's

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three pipeline systems that transport crude petroleum, petroleum products, and natural gas. Major pipeline nodes—pump stations, and junctions of five or more lines—would be ruined. And wiping out oil terminals would cut off imports almost completely, since unloading oil requires elaborate facilities.

Because fuel is needed to extract and transport fuel, the shortfall in petroleum would bring oil and coal production to a halt. Strip mining, for example, requires diesel-fueled power shovels and trains shuttling between coal fields and power plants. A return to less fuel-intensive mining techniques would drastically reduce yields, and transportation to power plants would still be problematical. The energy requirements for oil and gas extraction are even greater, and, of course, facilities to transport these fuels would no longer exist.

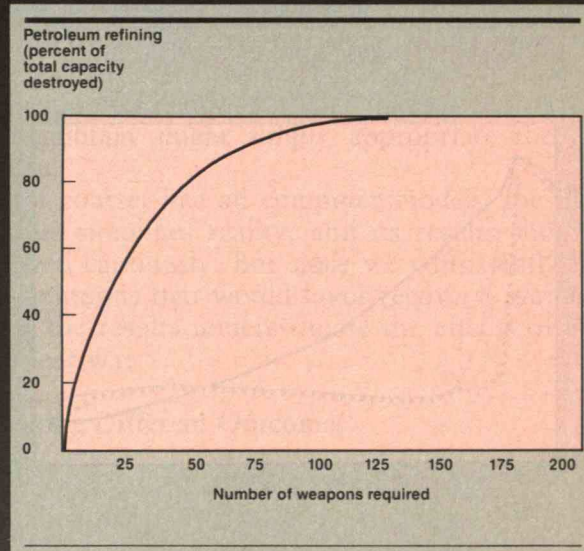
The point is that modern society depends on a minimum level of energy—an *energy threshold*. As the last stores of supplies vital for sustaining the industrial engine become depleted, the entire economy could change from a mechanized activity back to the manual labor characteristic of the Middle Ages. Returning to pre-attack levels would be a long, arduous process, with no assurance of success.

Indeed, survivors might become more concerned with finding safe shelter and uncontaminated food and water than with rebuilding the nation's economic infrastructure. If that happened, people would flee the cities to forage for food in the countryside, making recovery even more difficult. And the most severe consequences of an attack are incalculable—including the effects of radiation, hunger, trauma, and dislocation on future generations.

Modeling the Economy

To determine the calculable effects of such a devastating blow on the overall U.S. economy, we used a computer model based on system dynamics—one that accounts for complex relationships among industries. Earlier models that analyzed the effects of a nuclear attack oversimplified these relationships. Because they assumed that the economy would continue to operate much as it had in the past, these models were poorly suited to analyzing such an unprecedented shock.

We chose a system-dynamics approach because its primary source of information is the opinion of experts. Decision making—rather than its total results—is the focus. Researchers might interview



The Soviet Union could wipe out U.S. oil-refining capacity using only a tiny percentage of its nuclear arsenal. A few more weapons could destroy the three pipelines that transport petroleum and natural gas around the country, as well as the terminals that receive imports. Such a blow would bring the economy to a halt.

factory managers and shop-floor supervisors, as well as economists and industry consultants, to find out how they allocate resources and determine rates of production. The researchers then assign variables to factors such as order backlogs, delivery delays, expected prices, and people's views of the market's stability.

With the help of the FEMA model's authors, we improved the program's ability to represent the U.S. economy, especially the energy and transportation sectors. We made use of a detailed study of the geographic distribution of key industries, and an extensive Census Bureau inventory of U.S. population and manufacturing.

The model uses 1982 as the year the attack occurs. It divides the economy into 14 sectors. These include 11 areas of production: agriculture, capital goods, construction, consumer goods, energy, durable metallic materials, durable non-metallic materials, consumable materials (not including fuel), transportation, medical care, and other services. The final 3 sectors are imports, government, and private consumption. Equations represent relationships among the variables mentioned above, as well as their rates of change, for each production sector.

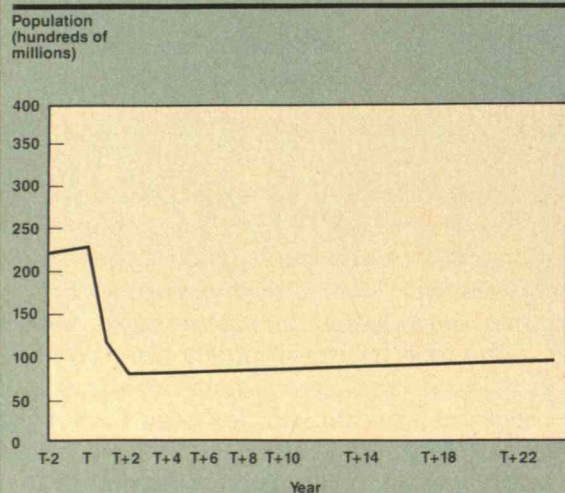
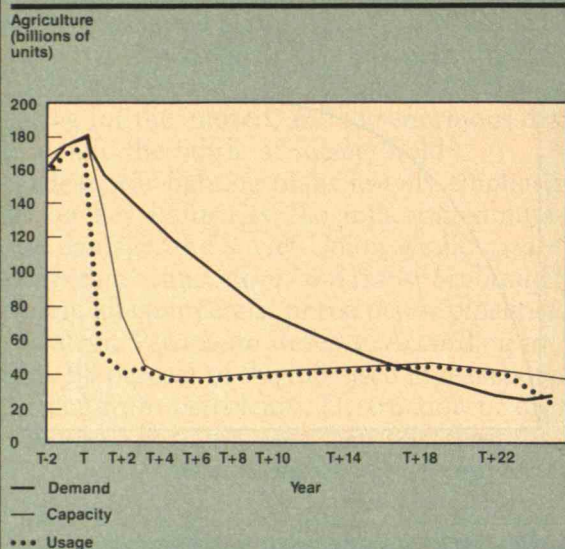
The model recalculates the value of each variable for every three weeks that pass, continuing for 25 years after the attack. By constantly updating variables based on their relationships with other variables, the model explicitly represents the dynamic evolution of the economy under the unusual conditions that would occur after a nuclear attack.

We do not claim that the program models a nuclear attack realistically. That is not possible. We claim only that this model is superior to previous ones, and that the outcome of a real nuclear war would be worse than what the results show.

The model was not constructed to perform traditional economic forecasting: we sought trends rather than exact values at specific times. But it does seem to work. To test its validity, we used the program to predict patterns of U.S. economic growth for the past 20 years. The results matched actual performance trends, both in overall GNP and in individual sectors (*see the charts on page 29*).

What the Model Showed

Despite its optimistic assumptions, the baseline scenario reveals that lack of transportation caused by the loss of refineries and imported petroleum would rip-



Although food would be available after a small nuclear attack, the lack of fuel—and thus transportation—would mean that people could not obtain it. Half the survivors could die of starvation. Imported food would not help, since ports would be destroyed.

The model assumes that people would act rationally during recovery. After a real attack, decisions would more likely be haphazard or worse.

ple through the economy, causing unprecedented damage. Even though we assumed that an agricultural industry would survive, the lost ability to transport and distribute food would cause half the survivors to die of starvation in the first two years—five times as many as would be killed by the attack itself. Though the attack would directly destroy only 8 percent of the nation's manufacturing capacity, mass starvation plus lack of vital supplies for industry would cut U.S. output in half the first year alone. And because no one would be available to rebuild devastated industries, the nation's production capacity would suffer for decades. Twenty-five years later, economic activity would still languish at 35 to 45 percent of its pre-attack level.

As mentioned, the baseline scenario assumed that the United States could import most goods at 20 percent of the pre-attack rate. Although petroleum requires special import facilities—which would all have been destroyed—we optimistically assumed that oil could be imported at 10 percent of its previous level. We also assumed that imports would rise in each later year, and that petroleum imports would double one year after the attack. Although energy shortages would persist for many years, investments in energy and transportation would bring the latter to 50 percent of its pre-attack level one and a half years later. More important, by this time we also allowed transportation capacity to equal demand, so it would no longer be a bottleneck to recovery.

The ratio of injured to dead among the casualties strongly influences the rate of recovery. Even though a portion of the injured survive to contribute later to the labor force, at first they exert a considerable drain on the economy by consuming food, shelter, and services that healthy survivors must provide. We made the gruesomely "optimistic" assumption that 80 percent of the casualties would be fatalities. Fewer deaths and more injuries would actually decrease the prospects for economic recovery.

Finally, the model assumed that people would act "rationally" during recovery: that financial institutions would remain intact and that authorities overseeing reconstruction would begin with complete information on the state of the economy, inventories available, and facilities destroyed. And these authorities would make the most rational decisions in allocating scarce energy supplies among the competing demands of distributing food, rebuilding energy facilities and ports, and providing transportation and fuel for industry. Failing to deal

with any of these needs would prove disastrous.

After a real attack, decisions would more likely be haphazard or worse. For instance, rather than allocate petroleum in a way that speeds recovery, the military might simply appropriate the lion's share.

Of course, like all computer models, the FEMA model simplifies reality, and its results should be viewed cautiously. But since we consistently made assumptions that would favor recovery, we believe that the results underestimate the effects of a real nuclear war.

Positing Different Outcomes

In testing our model, we found that the availability of labor, as opposed to, say, higher levels of imported goods, is the key to economic recovery. And apart from death and injury, what most influences labor availability is the population's morale: whether people are willing to trust authority and do what they are told to assist in a common recovery. Our baseline scenario assumes that survivors are not psychologically affected, that they remain obedient to authorities, and that they stay in cities to rebuild transportation and other industries. Yet as we have seen, even in this unrealistic situation, half of them starve within a few years.

In another scenario, we assumed that the population is psychologically unable or unwilling to be productive. Whether because of the shock of the attack or because their highest priority is to feed themselves and their families, people migrate out of the cities to areas where food is grown.

In this scenario, people do not immediately starve, but the economy collapses completely within three years. (See the chart on page 26.) With the working population putting all its efforts into survival, and with much of the remaining energy and vehicles devoted to moving people to farmlands, little if any labor is available for rebuilding transportation.

Some people in both urban and rural areas would probably farm in spots and patches using labor-intensive techniques that do not rely on fossil fuels or machinery. However, it is not clear that such methods, in the absence of petrochemical fertilizers and insecticides, could support anywhere near 200 million survivors. In fact, a population of 60 million is more likely. In other words, an even larger percentage of people would starve over the longer term than in the baseline case, and the economic devastation

The Soviet Union may be even more vulnerable than the United States to a small nuclear attack.

would be much more severe.

We also analyzed what would happen if only part of the workforce showed low morale and removed itself from urban industrial activity. The results show the economy languishing at about a quarter of its pre-attack level 25 years later.

To further test the model, we simulated import levels higher than in the baseline scenario. First, we doubled food imports to 40 percent of pre-attack levels in the first year and allowed them to increase 20 percent every year thereafter. Fewer people would starve, and probably fewer would leave industrial centers, so GNP would be about 15 percent higher.

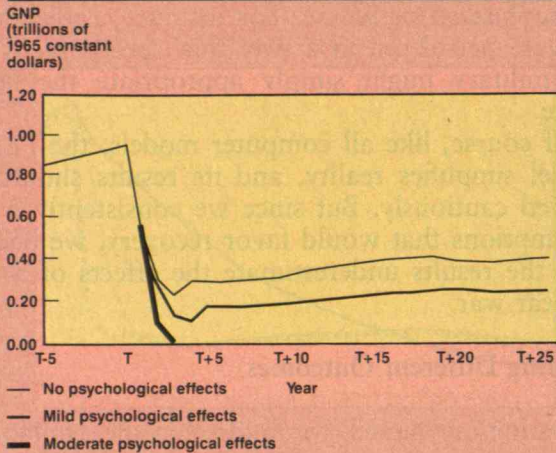
When we doubled *all* imports, GNP showed no further improvement, confirming the fact that food is the critical variable. When we tested even higher import rates, we noticed an interesting effect. They improved the economy somewhat in the short term but were counterproductive in the long term. The economy became dependent on imports rather than rebuilding its own manufacturing base.

More likely, with every commercial port destroyed, import rates would be lower than in the baseline case, with energy imports initially reduced to a trickle, say 5 percent of the pre-attack level. Food would be scarce worldwide after the United States, and possibly Canada, stopped exporting it. Even if food could be imported, the absence of transportation would make distribution difficult, so imports would have little effect on reducing starvation.

Finally, we hypothesized that transportation capacity would exceed demand within months of the attack, and that the vast majority of equipment would return to pre-attack levels within two years. In this extremely optimistic case, GNP turned out to be higher and recovery faster. Yet the economy still functioned at only a third of its previous level 25 years later.

Since our baseline assumptions were optimistic, we believe that less transportation, not more, would be available. In that case, the prospects for any kind of recovery—and for the survival of a nationally integrated, complex economic system—appear bleak.

The Soviet Union may be even more vulnerable than the United States to a nuclear attack of similar size. The Soviets' urban population density is more than double ours, and their ability to feed their people



In each post-attack scenario, the U.S. economy languishes at no more than a third of its former strength 25 years later. In the most optimistic case, survivors remain in cities and begin to rebuild transportation and industry. In the second case, some people flee to rural areas to search for food, so the economy remains at only a quarter of its previous level. In the third—and most likely—case, most survivors migrate to the countryside. Fewer people starve in the short term, but the economy collapses completely with no one to rebuild it.

in peacetime is far below ours. Soviet industry, especially petroleum, is more concentrated and nearer to urban populations. And since the central Soviet regime exercises repressive control over most of its population, the country would seem more likely than the United States to fragment under the centrifugal forces of nationalism following a nuclear attack.

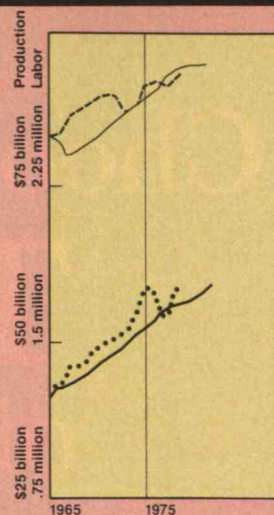
Since the Reykjavik summit, the United States and the Soviet Union seem to have moved toward an understanding that deep reductions in nuclear arsenals are worthwhile. Clearly, if the two nations can agree to maintain only a force capable of inflicting unacceptable damage to the other society, then both sides could reduce their arsenals by more than 90 percent.

An effective deterrent need comprise fewer than 1,000 nuclear weapons. This would still allow each side to deliver a devastating strike even if some weapons did not reach their targets, or if some were destroyed in a first strike. Such severe cuts might be difficult to achieve politically, but militarily they would be sound. In this light, the 50 percent reductions now being considered in the U.S.-Soviet START talks are a small but important first step. Certainly neither side needs any new nuclear systems to deter a first strike.

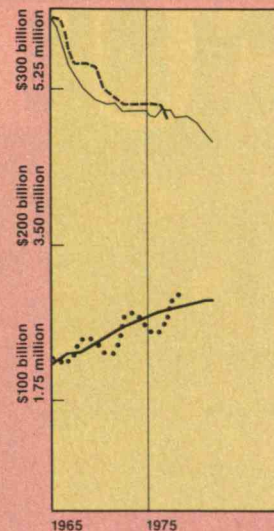
Our results also show that the Strategic Defense Initiative is a worthless expense if it is intended to keep the country from collapsing under Soviet attack. The number of weapons that could devastate this country is simply too small—a 99 percent effective defense would not do the job. And even if the proposed anti-ballistic missile system were to do the impossible and be 100 percent effective, the Soviet Union could still ruin the U.S. economy using cruise missiles and bombers, which SDI is not intended to defend against. Nor could SDI deflect attacks by submarine-launched ballistic missiles that have low trajectories. Those could easily attack the vast majority of U.S. liquid-fuel facilities, which are on or near coasts.

The Bush administration has a splendid opportunity to eliminate the overkill of the world's nuclear arsenals and save money in the process. Some Soviet scientists have said that 600 weapons on each side are enough to maintain deterrence and stability. Our results give us no reason to doubt them. ■

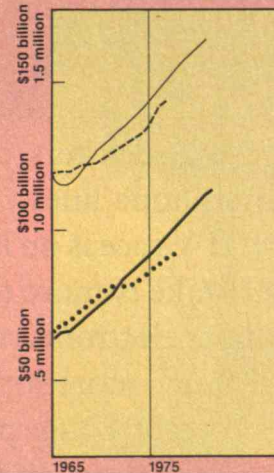
Transportation



Agriculture



Energy products



— Simulated labor
 - - - Historical labor
 — Simulated production
 Historical production

The authors used their model to “predict” growth in key U.S. industries during the 1960s and 1970s. The program’s results matched actual trends for both labor and production.

Choosing the TV of the FUTURE

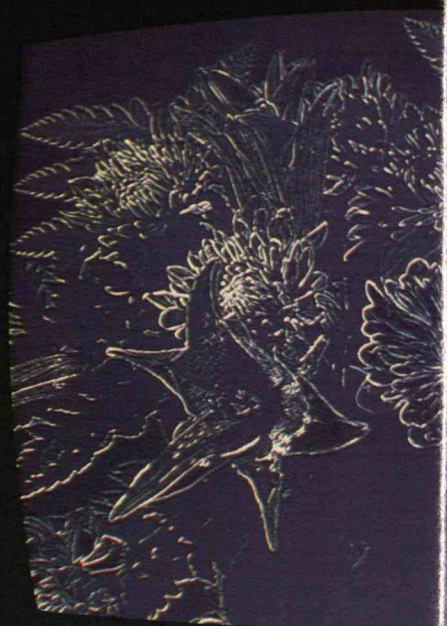
BY HUGH CARTER DONAHUE

Cable and VCRs transformed television in the 1970s and 1980s, providing unheard-of variety and flexibility in programming. High-definition television promises to have an even greater impact in the 1990s. HDTV sets will show high-resolution pictures on large, extra-wide screens, and will produce the crystal-clear sound of a compact disc. They may also be smart enough to store and retrieve electronic still pictures, allow two-way video communication, and receive programming in different formats from broadcasters, cable, satellites, and perhaps even fiber-optic phone lines.

The HDTV race is on in Japan, Europe, and the United States. At stake is more than just each country's share of the consumer electronics market. Because the new receivers could use much more sophisticated gadgetry than today's sets, they present a huge potential market for microprocessors, memory chips, and other devices. So leadership in

**THE STAKES ARE HIGH
IN THE SEARCH FOR A BROADCAST
STANDARD FOR HIGH-DEFINITION
TELEVISION.**





HDTV might dramatically boost a country's standing in other key areas.

By virtue of seniority, the Japanese are leading the pack. NHK, the Japanese Broadcasting System, began developing high-definition television in the 1970s. Together with electronics giants such as Sony, Matsushita, and Hitachi, NHK demonstrated a working system in 1981 with 1,125 scanning lines—more than twice the 525 lines that form a conventional U.S. television picture. The Japanese initiative encompassed equipment like cameras, picture tubes, a video recorder, and a scanner for transferring films to videotape.

The first system the Japanese devised, for broadcast from satellites, consumed 32 megahertz of bandwidth—too much for broadcast from stations on the ground. But reduced-bandwidth versions have followed. NHK plans to deliver high-definition pictures by direct-broadcast satellite (requiring a dish for each receiver) and cable in 1990 and by terrestrial broadcast a couple of years later.

Europe is not far behind. At a 1986 meeting of the Comité Consultatif International de Radiodiffusion—a worldwide standard-setting organization—European representatives turned down Japan's bid to make the NHK system the international standard. (See "Europe's HDTV," page 39.) Eureka, Europe's 19-nation technol-

ogy development program, then mobilized to create its own high-definition format for European markets. Experimental satellite transmissions are planned for later this year; full HDTV satellite and cable service, for 1995.

The United States is bringing up the rear. The combination of less public-private cooperation, stricter antitrust regulation, and fewer major TV manufacturers (one, to be exact) has led to a slower start in developing HDTV. And with 160 million television receivers and 1,300 broadcasters—far more than Japan or Europe—the United States has to overcome a lot of inertia in switching to a new standard.

Some Americans argue that Japan's and Europe's lead is too great for the United States to become a serious player in HDTV. Better, they say, to concentrate on software and video programming and concede receiver manufacturing to the frontrunners. But the United States does stand a chance. Because they started so early, the Japanese are building upon dated 1970s technology. They are "ahead" only because they can demonstrate working prototypes. European firms, though eager to market HDTV wares in the United States, are building primarily for Europe. And their equipment is tailored to European TV's 50 images per second, so they would have to modify it to fit the U.S. standard of 59.94.

HDTV presents an opportunity for the United States to leapfrog the Japanese and challenge the Europeans. But first, U.S. television interests must decide what standard or standards they are going to follow. Since the

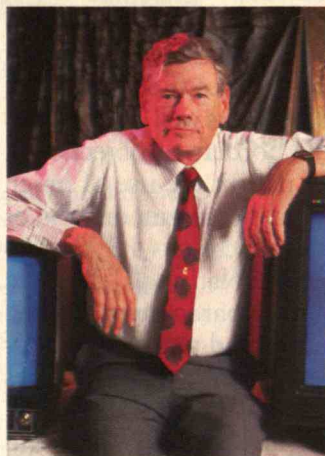
*HUGH CARTER DONAHUE, who received a Ph.D. in communications and policy analysis from MIT in 1985, teaches journalism at Ohio State University. His book *The Battle to Control Broadcast News: Who Owns the First Amendment?* (MIT Press, 1989) chronicles the political uses of broadcasting from Coolidge to Bush.*



1940s, American transmitters and receivers have been based on a scheme set by the National Television System Committee (NTSC). Last September, the Federal Communications Commission ruled that a high-definition system could not render NTSC equipment obsolete overnight. The FCC mandated a transition period of unspecified length during which viewers will have a choice of watching conventional pictures on their old sets or buying new HDTV sets.

No matter what sort of standard the FCC chooses, some video programming industries may not hew to it. Direct-broadcast satellite (DBS), cable, and videocassette are not regulated by the FCC in the same ways as broadcast and do not have the same bandwidth constraints. Broadcasters, each allotted 6 megahertz of bandwidth, must share the limited airwaves with two-way radio and other users. The newer technologies can either adopt the 6-megahertz broadcast HDTV standard, and thus preserve unanimity, or develop their own wide-spectrum standards, and thus deliver consumers an even better picture.

If these industries choose the latter course, the United States will end up with a family of incompatible standards. This might not be as bad as it sounds. A radical new concept in set design known as the open-architecture receiver would allow viewers to watch programming transmitted by different media using different standards. This "smart" TV set, under development at MIT, would provide a big market for U.S. semiconductor firms and wrest some of the initiative in HDTV away from Japan and Europe.



VISTA, a high-definition system developed by William E. Glenn (left), augments a regular TV picture with fine detail sent over a separate, narrower channel. Normal sets display only the standard picture (above left). Special sets pick up the extra channel (center), producing a crisper image (right).

WHEN HDTV'S BIG, CLEAR PICTURE IS COMBINED WITH CD-QUALITY AUDIO, WATCHING TELEVISION SHOULD BE JUST LIKE GOING TO THE MOVIES.

A Sharper Image

HDTV improves on NTSC in some big ways. Instead of the current 525 lines, it can have as many as 1,050 or 1,125 lines. And although some proposed systems display pictures the same way as NTSC, which interlaces two half-images, or fields, in quick succession (transmitting first the odd-numbered lines, then the even-numbered lines, and letting the mind's eye do the rest), many use "progressive" scanning. That is, they scan the whole picture in one continuous sequence, simultaneously boosting resolution and cutting flicker. If the system also shows twice the number of lines, resolution is further increased.

HDTV also clears up some of the annoying defects of broadcast television. For example, information for light and color in NTSC is interleaved on the same signal. Because the two types of information overlap slightly, today's receivers can mix up color and light, especially in detailed patterns. That's why a herringbone coat often shows up with splashes of rainbow color in it. With twice or four times the resolution, HDTV greatly reduces this defect—as well as problems such as flickering around the borders of objects.

The improved picture will permit the use of much larger and wider screens. The aspect ratio, or ratio of width to height, of a conventional screen is 4:3, the format for movies in 1936 when the National Television System Committee began setting parameters for TV. Since the 1930s, films have adopted a ratio of either 1.85:1 or 2.35:1 for greater impact. As a result, movies shown on TV must be cropped. Many HDTV developers plan to use an aspect ratio of 16:9, which will allow movies to be transmitted in a form much closer to their original composition. (Regular sets will show either a cropped version of the HDTV picture or a full version with black bands at top and bottom.) When this big, clear picture is combined with the CD-quality audio that most HDTV proponents are developing, watching TV should be just like going to the movies.

The Standards Race

Roughly 20 HDTV proponents are seeking FCC approval of their broadcast system as a national standard. A private-sector advisory committee to the FCC will begin tests on competing formats late this year. The committee has to assess proposed systems' compatibility with today's receivers, the number and bandwidth of channels required to carry the high-definition sig-

nal, display size, aspect ratio, and vertical, horizontal, and dynamic (motion) resolution. Because only proposals with prototype hardware will be tested, the many developers whose systems exist only as computer simulations are racing to build prototypes. By late 1990 or early 1991 the committee plans to report its findings to the FCC. In 1991 or 1992, the FCC should be ready to render a decision.

At this point, who will win out is anybody's guess. Nevertheless, a half-dozen proponents have attracted more attention than the others, and might be regarded as frontrunners. They include French-born inventor Yves Faroudja (of Sunnyvale, Calif.), NBC and RCA/Sarnoff Research Center (a subsidiary of SRI International that is developing technology owned by France's Thomson), Dutch-owned North American Philips, William E. Glenn of the New York Institute of Technology, Zenith (America's last major set manufacturer), Japan's NHK, and MIT's William F. Schreiber.

These players represent three fundamentally different approaches to the problem of delivering high-definition pictures without cutting off the millions of viewers with conventional sets. One approach is simply to beef up NTSC—a scheme known as enhanced-definition television (EDTV). Another is to augment an NTSC channel by broadcasting additional information over a channel elsewhere on the spectrum. In the third approach, known as simulcasting, each station would transmit two separate signals: one for old receivers and one for new.

EDTV: Claiming "we have not squeezed all the juice from NTSC," Yves Faroudja says he can make the old system look and sound virtually as good as HDTV. In his SuperNTSC system, transmitters eliminate visual defects with filters that keep the light and color signals from interfering with each other. This should produce a noticeably better picture on all color sets. But Faroudja proposes coupling this cleaned-up signal with more sophisticated receivers. North American Philips, Hitachi, and other manufacturers already market "improved-definition" sets that enhance picture resolution by storing a frame in a digital memory and then displaying it between the lines of the next frame. Faroudja has developed a similar receiver that provides a 1,050-line interlaced picture. To transmit and receive CD sound, he plans to use a new digital encoding technique developed by Dolby.

Faroudja claims that the equipment needed for his system would cost less than that for augmented or simulcast formats. He began field-testing SuperNTSC

Television and the Economy

AN INTERVIEW WITH WILLIAM F. SCHREIBER

Although the Japanese have been developing a high-definition television (HDTV) system with a radically improved picture for some years, until recently only a few individuals in the United States were interested in this technology. One of them was William F. Schreiber, director of MIT's Advanced Television Research Program.

One idea Schreiber advocates is the open-architecture receiver (OAR), which is not so much a particular HDTV system as an approach to designing HDTV. Signals arriving at the receiver would be sent through a signal-processing module that would translate them for display on the screen. This module could accept signals in a variety of formats from media such as over-the-air broadcast, cable, VCRs, satellite broadcast, and digital fiber optics that phone companies plan to put into every home. Such flexibility in the receiver would make it easier to design transmission systems that would work well in the various media. If any of the signal formats were improved, the receiver could be reprogrammed or an inexpensive new signal-processing module could be plugged in, as in a video game.

As interest in HDTV has mushroomed, Schreiber has attempted to explain the economic as well as the technical advantages of OAR. Since the processing module is essentially a computer, he believes U.S.-owned computer firms, which already produce video display terminals, could competitively manufacture such HDTV receivers, capturing a significant share of this important market.

Schreiber testified about the OAR system in 1987 and again in 1988 at hearings held before the House Subcommittee on Telecommunications and Finance, chaired by Rep. Edward Markey (D-Mass.). When the committee sought comments on what the government could do to increase the market share for U.S. companies in high-definition television, Schreiber provided advice. He also serves on a Commerce Department committee concerned with similar issues. Last December, the Defense Advanced Projects Research Agency (DARPA) announced that it will provide \$30 million for HDTV research, and showed particular interest in the open-architecture receiver.

Technology Review recently interviewed Professor Schreiber about the economic importance of HDTV.



WILLIAM F. SCHREIBER

Why has DARPA, the advanced research arm of the Pentagon, become interested in improving television pictures?

In the military, whenever you look at a tube, you want high definition. The armed services are legitimately interested in this technology. But they're also interested in providing a market for U.S. semiconductors. We've decided we need the semiconductor industry. The easiest way to make it live is to provide a market for its products, as in Japan, where more than 40 percent of the semiconductor industry's output goes into consumer electronics. Here it's less than 10 percent.

Granted that we need markets for semiconductors, why is HDTV so important compared with all the computers that the United States makes?

Right now we have 160 million television sets in this country and at most 10 million computers. High-definition sets are going to use a lot of chips, some of them quite sophisticated—not only memory chips but microprocessors and digital signal-processing chips. That's a very big market, potentially bigger than the entire computer industry.

You are assuming that the United States will adopt an open-architecture system, or at least an advanced high-definition television?

Even without the open-architecture system, you're going to need a lot of processing power. At minimum, each HDTV receiver is going to have to cope with at least one new high-definition signal plus the National Television Standards Committee signal that is broadcast today. The way the Japanese cope with NTSC is to convert its 525 scan lines up to the 1,125 lines that their MUSE high-definition television system displays. That takes a lot of circuitry, a sizeable digital signal processor. So even the Japanese are saying that HDTV sets are going to be quite complex compared with today's sets.

For HDTV to provide a large market for semiconductors, it will have to succeed commercially. The first receivers are estimated to cost \$3,000. Is there any reason to believe consumers will spend so much?

That sounds like a lot of money, but that's how much black-and-white receivers cost in today's dollars when they first came out, and it's how much color receivers cost when they came out. Any new product starts slowly, and sales build up as the price goes down. So if this is a really radical advance in technology, there's some prospect people will pay that \$3,000.

But if the picture is not much better, I don't think consumers are going to buy it in any large numbers, and that could happen. Much of the industry is talking about an enhanced version of the current NTSC signal. Existing sets could pick it up and new sets would get a picture with greater resolution. But those who advocate such systems have not faced up to the problem of transmission defects. The picture quality in American homes is terrible, and the reason is NTSC. It's extremely vulnerable to problems such as snow (white flecks that appear on the screen), multipath (where the signal has more than one path to a receiver and causes ghosts), and interference (which causes a second picture to appear). If the signal is bad, adding a few more lines of resolution doesn't make any difference. As a result, people are not going to buy many of the new sets.

There is a whole series of things wrong with NTSC that results from the fact that it was designed in 1941 for very simple receivers. If you start with a blank slate and

last October in two California cable systems operated by Tele-Communications, Inc.

AUGMENTATION: NBC and RCA/Sarnoff propose a two-stage approach that would culminate in an augmented system. The first stage would be an enhanced-definition system called ACTV-1, which would require only 6 megahertz. The picture would appear normal on an regular set, but new receivers would get a wider aspect ratio and slightly better resolution. Later, the company would introduce ACTV-2, a 12-megahertz augmented system. The additional 6 megahertz would come from one of the adjacent channels currently left vacant to avoid interference. ACTV-2 would provide CD-quality sound and a 1,050-line picture—interlaced at first, but perhaps eventually scanned progressively.

The developers claim that their evolutionary system would speed consumer acceptance of high-definition television and allow broadcasters to upgrade gradual-

ly instead of undertaking a wholesale conversion. On the downside, the FCC is unlikely to allot 12 megahertz of spectrum to each ACTV-2 channel even if the developers can prove that these stations would not interfere with adjacent neighboring channels.

North American Philips also proposes an augmented format. Its High Definition System for North America (HDS-NA) combines a conventional 6-megahertz signal with an additional 3 megahertz from a nonadjacent channel. The extra bandwidth will carry the picture information needed to fill a wider screen (16:9), twice today's resolution, and digital sound. Ultimately, NA Philips intends to send the extra information digitally. The company claims that this will take less power

NBC and RCA/Sarnoff propose an evolutionary shift (left to right): from today's picture, to an "enhanced-definition" picture that needs only a single channel, and finally to a high-definition picture that takes up two full channels.

INTERVIEW

CONTINUED FROM PAGE 35

use modern technology, you can build a better television system.

If you go to a totally new HDTV system, for some time you would have to broadcast both that signal and the NTSC signal for existing sets. Is there enough room in the electromagnetic spectrum, given other demands such as mobile phones?

Zenith claims that it can transmit new high-definition signals at such a low power that they can use today's taboo channels—the channels left empty to avoid interference. The company hasn't demonstrated this yet, but even if the approach doesn't work everywhere, in a lot of areas UHF channels are available. And in the half-dozen largest cities where there may be no UHF channels available, the government could let the more profitable stations buy less profitable stations to secure the channels to broadcast both HDTV and NTSC signals.

Don't broadcasters and receiver manufacturers still oppose a new HDTV system, and especially the open-architecture receiver?

When I first explained the OAR in 1987, the Electronics Industry Association, a group of primarily foreign-owned producers of television receivers, was so incensed at the idea that they sent a long letter to the Federal Communications Commission (FCC) denouncing it. They've used the commodity-type receiver that's made on a cookie cutter as one of the weapons to put American companies out of business. So as far as they're concerned, that's the right way to build television receivers. The EIA would love the government to forget about high-definition television. Such a radical idea as building a receiver for the 1990s based on 1980s technology rather than 1950s technology is very difficult for them to accept.

For broadcasters, it is very hard to face the phase-out of NTSC. When they think of all the equipment they own and all the receivers in the country, the transition scenario that's required, and the competition from cable, it's a really difficult business decision to make. But unless they go with something modern and get rid of NTSC, in the end they're not going to have a good enough system to compete with the alternative media.

The FCC intends to regulate high-definition signals broadcast over the air but not via media such as cable, VCRs, or even satellite broadcast. Would this be enough to lead to a good HDTV system for the country?

If the FCC sticks with its intention to regulate only over-the-air broadcast, you might

see four or five different formats being used. Then consumers are going to purchase receivers that can't be used with some of the available signals. And that's going to kill high definition.

Some people say economic necessity will force different media to have a compatible scheme, but that's not what these media are saying. Only the broadcasters want everybody to use the same standard, and that's because they have the worst channel. The alternative media are saying they don't want to be limited by the quality that can be achieved over the air. What got the broadcasters alarmed about the HDTV issue two years ago was the thought that in 1990 the Japanese would start shipping in high-definition VCRs and receivers, and viewers would watch them instead of tuning in to Channel 4. Those VCRs and receivers would not be compatible with NTSC.

Could the FCC establish HDTV formats for all these media—cable, VCRs, direct broadcast from satellites, even the telephone companies' proposed fiber-optic transmissions?

That would be a perfectly reasonable approach for government to take. No one has to regulate how receivers are made, just their performance standards—the face they turn to the outer world. Congress would probably have to pass additional laws, which it might well let the FCC administer. Consider the All-Channel Receiver Act of 1962, which



requires television receivers sold in the United States to receive UHF. Prior to that, UHF was a chicken-and-egg problem. Why should a manufacturer increase its costs by providing a UHF tuner when there were no UHF stations? And who's going to broadcast if there are no receivers? The law protected manufacturers because no one could gain a cost advantage by putting out a receiver without this capability.

If the United States goes ahead with such HDTV standards, is there any guarantee that all the sophisticated electronics are going to be made in the United States?

There is no way that American companies could get all the business, but they may well get a good part of it. After all, the American computer firms are in pretty good condition. A lot of the equipment is manufactured in the United States. Tandy, for example, manufactures almost everything domestically. IBM does a lot of manufacturing in the United States. Hewlett-Packard claims to be the lowest-cost terminal manufacturer in the world, and they make their terminals in California. DEC makes terminals competitively in Albuquerque. The plant there is highly automated and has almost no people. I visited it, and it's really eerie.

Has DARPA's backing for HDTV research had any effect on U.S. industry's interest in the technology?

It's been an education to me because \$30 million is peanuts to the military, it's peanuts to any big company that's serious about going into television, and furthermore, the money will be divided among a number of companies. Yet the \$30 million has managed to stir interest from most of the large computer and electronics companies in the United States.

Within a week or two after the announcement, our lab was approached by five major firms about going in with them on bids. And they are bidding in such a way that they themselves will spend most of the money, and they'll only get a couple of million dollars each from DARPA. It's psychological. DARPA has put its imprimatur on high-definition television.

Are you concerned to see the military stepping in, championing a technology that civilian companies apparently hadn't caught on to?

At least somebody is stepping in. As I mentioned, the Pentagon needs this technology. And the military people believe—and I agree with them—that the strength of this country is in large measure in its industrial power. When World War II started, President Roosevelt decided he needed 50,000 airplanes a year, so we tooled up and made 50,000 planes a year. If we have no consumer electronics in the United States, we're never going to be able to tool up and do anything important.

Congress, the Commerce Department, and even the FCC have been concerned about how the United States can get an adequate share of the HDTV market, but has the government done anything about it?

The Commerce Department committee on HDTV and several other groups have talked about forming a government-sponsored corporation, the Television Corporation of America (TCA), in the same way that Comsat or RCA were established. Here's how it works: A law is passed to let competing companies contribute to an independent corporation in order to establish a presence in a field that the government thinks is important. RCA was formed as a result of the U.S. Navy's requirement for communications equipment, and Comsat was formed because the government wanted a company to provide satellite communication services. TCA would be set up to develop and manufacture high-definition television receivers.

Why would it be in the interests of an individual corporation such as IBM or Zenith to contribute to, in effect, a competitor?

They would expect to get technology back, and they might do it out of public-spiritedness. I was very impressed with what I saw at the Commerce Department meetings. These people seemed relatively civic-minded—the presidents of AT&T, Tandy, Motorola, Zenith. They're all looking at this issue very seriously. ■

UNLESS THE PICTURE IS DAZZLING, CONSUMERS WON'T PAY THE \$2,500 TO \$4,000 FOR AN HDTV SET.

and hence cut down on interference with nearby channels.

In all the proposed systems, there is a tradeoff between resolution of static images and resolution of motion. NA Philips is gambling that providing relatively modest definition but high dynamic resolution (the same as today's) will blow away competitors that do the opposite. Viewers, the company asserts, would rather be able to see the grain on a hurtling football than finer detail on fixed images.

The company points out that, at a total of 9 megahertz, HDS-NA uses spectrum more efficiently than 12-megahertz augmented systems. On the other hand, no one has built a working prototype of a 6+3 system. It remains to be seen whether the augmentation channel, which transmits at a different frequency, can be decoded well enough to produce sound and pictures that will impress consumers.

NA Philips says it will begin marketing high-definition sets by 1993 if the FCC sets a transmission standard by 1991. Last October, Philips Laboratories and Hughes Communications announced a joint \$2.5 million investment to test satellite delivery of HDS-NA.

Another 6+3 proposal comes from William E. Glenn, former director of research at CBS Laboratories and now director of the New York Institute of Technology's Research Center in Dania, Fla. Glenn's theories about resolution run directly counter to those of Philips. The resolution of static images in his VISTA system is extremely high. But to squeeze so much picture information into a 3-megahertz augmentation channel, Glenn transmits fine detail at a slower rate—only 7.5 frames a second. He argues that the eye does not perceive motion any more accurately than VISTA depicts it. Like Faroudja, Glenn plans to use Dolby technology for digital sound.

SIMULCASTING: Instead of building HDTV on top of an NTSC signal, Zenith makes the high-definition signal an entity unto itself. The company proposes that broadcasters simulcast, or transmit a separate high-definition signal on the vacant 6-megahertz channel next to their existing NTSC frequency. An HDTV receiver would pick up only the high-definition signal. Freed from the constraints of the current standard, the high-definition signal can contain a lot more information. In fact, thanks to digital signal processing, Zenith's system is able to carry 30 megahertz worth of video and sound in 6 megahertz of bandwidth.

Zenith accomplishes this by splitting up the high- and low-frequency portions of the HDTV signal. High fre-

quencies, which contain the picture information, take less than 1 percent of the energy needed for transmission. Zenith sends this part of the signal in analog form. The normally power-hungry low frequencies—carrying the pulses that keep receivers in sync with transmitters—are digitally encoded and sent through the vertical blanking interval (the black band that separates frames of video). This approach leaves a lot more room in the channel for picture information. Zenith says it also requires less energy, thus preventing the high-definition channel from interfering with the adjacent conventional channel.

Zenith, which plans to license the encoding and transmission technologies, claims it will take three to five years to field-test the system and bring sets to a mass market.

Japan's NHK is hedging its bets. MUSE—a compressed, 9-megahertz version of NHK's original 32-megahertz high-definition system—is not compatible with today's receivers, so the FCC ruled it out last September. But NHK is offering the commission its pick of three newer formats. MUSE-6, intended as an interim system, is a 6-megahertz enhanced-definition format compatible with NTSC. The 9-megahertz MUSE-9 is a 6+3 augmented format. Narrow Muse, the most spectrum-efficient of the lot, is a 6-megahertz simulcast system.

Toward a Family of Standards

In deciding on a standard, the FCC will have to wrestle with a number of thorny economic questions. First is the tradeoff between schemes based on NTSC—enhanced-definition and augmented systems—and simulcast systems. The former would probably be cheaper to implement. Proponents like NBC/RCA/Sarnoff and NA Philips claim that upgrading current studio and broadcast equipment would cost less than converting to all-new technology.

But simulcast proponents counter that the difference in equipment costs may not be great. They also assert that simulcasting is ultimately more efficient. Once high-definition television became the norm, they say, the old NTSC channels could either be converted to provide additional HDTV stations or be used for something other than television.

Simulcasters claim better picture quality as well, because their high-definition signals are not wedded to NTSC, which is highly susceptible to interference and noise during transmission. The first high-definition sets

Europe's HDTV: Tuning Out Japan

BY ALAN G. STODDARD
AND MARK D. DIBNER

As factions in the United States haggle over the future of American television, Europe is responding quickly and efficiently to the Japanese bid for domination of high-definition TV markets. At an international conference in May 1986, European nations strongly opposed the adoption of a world HDTV standard based on the system developed by NHK, Japan's national television network. Barely a month later, four electronics firms petitioned Eureka, the pan-European R&D program, to support development of a European HDTV standard. Eureka agreed.

Why a separate standard for Europe? The reason given was that NHK's system, which displays 60 images a second, would be hard to adapt to conventional European TV sets, which display 50 images a second. But NHK has shown that it can convert between the two rates with a minimal loss of image quality. The real reason Europe is going its own way seems to be one of economics. The Europeans want to ensure that they stand at least as good a chance of succeeding in their own market as do the Japanese.

Today, Eureka 95—the HDTV development effort begun by Bosch of West Germany, Philips of the Netherlands, Thomson of France, and Thorn-EMI of the United Kingdom—encompasses a large number of European electronics and optics companies. All are in a race against time. The international broadcast-standards body, Comité Consultatif International de Radio

diffusion (CCIR), is holding its next plenary assembly in May 1990. By then the Europeans hope to be able to demonstrate a working HDTV production system that would provide an alternative to NHK's.

Unlike the NHK system, which produces images with 1,125 lines of vertical resolution, the Eureka 95 system will have a resolution of 1,152 lines. The HDTV signal will be carried over Europe's new multiplexed analog component (MAC) system, developed originally to encode TV signals for satellite transmission but recently adopted by the European Broadcasting Union for cable delivery as well.

part of the extra-wide picture should appear on the narrower standard TV screen. Meanwhile, viewers with neither cable nor satellite service will still receive conventional terrestrial broadcasts.

Out-Cooperating the Japanese

Japan was first to market in HDTV (Sony has been offering a full line of HDTV studio equipment since 1983), but with the Eureka 95 standard, the Europeans have effectively negated this advantage, at least within home markets. Ironically, they have done this in a very Japanese way. The Eureka program stimulates the same high

**HAVING SPENT OVER
\$100 MILLION ON THE EUREKA 95
STANDARD, EUROPEAN GOVERNMENTS
WILL DO EVERYTHING IN THEIR
POWER TO ENSURE ITS
SUCCESS.**

Viewers with satellite dishes or cable hookups will have the option of buying special sets to get the wider, higher-resolution HDTV pictures. But those who prefer will still be able to watch standard European 625-line pictures on their old sets. The inexpensive MAC decoders attached to their sets will average each successive pair of HDTV scan lines and display it as a single line. In addition, signals embedded in the HDTV transmission will indicate which

level of cooperation between government and business, as well as within the business community itself, that is the hallmark of Japanese industrial policy. Indeed, the Europeans are practicing cooperation at an even higher level than the Japanese—from government to government—on projects such as HDTV.

Founded in 1985, Eureka is a joint R&D effort of 19 European countries. It aims to promote multicorporation,

multinational projects in advanced technology and to speed the transfer from research to product. (See "Eureka!" in *TR*, August/September 1988.) Participating companies retain all rights to any technology developed during a Eureka project. As a result, the European effort offers the promise of tangible results, and provides the means to directly counter threats from the Japanese or others.

Beyond ensuring cooperation, European governments have backed up their commitment to industry with partial funding of the HDTV project. The funding, roughly half the project's \$232 million budget, is significant in monetary terms, but it is even more significant in the message it sends to European consumer electronics firms. Having spent over \$100 million on Eureka 95, European governments are likely to do everything in their power to ensure that HDTV in general, and the Eureka 95 standard in particular, is a success.

Participants in Eureka 95 hope their system will earn the CCIR's blessing as the single worldwide HDTV standard. Yet with over 30 companies already manufacturing commercial HDTV production equipment based on the NHK standard, the committee is unlikely to turn its back on the Japanese system. The best the Europeans can realistically hope for is recognition of Eureka 95 as a co-standard, just as color television today follows several different standards worldwide.

Nevertheless, by differentiating the European market from those in Japan and the U.S., Eureka 95 will give European companies an edge in their home markets, buying them needed time in their efforts to compete with the Japanese in the United States. ■

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of any kind are expected to cost \$2,500 to \$4,000. Unless the picture is dazzling, say the simulcasters, consumers won't pay the extra money. Thus the quality of reception may be as crucial as the quality of programming in determining whether HDTV flourishes or fizzles.

Then there is the question of who will own and control the technology. If a European or Japanese concern gains FCC approval for its proposed television standard, the economic implications for the United States might be serious. (See "Television and the Economy," page 25.)

But even if a U.S. firm wins the contest, there is no guarantee that all video programming industries will rally behind the standard. The cable and satellite industries believe they can provide better HDTV than broadcast, which is limited to a bandwidth of 6 or 9 megahertz. They contend that each industry should develop the format best suited to expanding and serving its consumer base. Since neither cable nor DBS would interfere with the broadcast spectrum, each could launch into high-definition programming without formal FCC approval. Conceivably, the direct-broadcast satellite industry could carve out a large market niche by beaming HDTV to receiving dishes before broadcasters come on line with the FCC standard. In fact, Hubbard Communications, a DBS pioneer, plans to start transmitting some HDTV programming from a new satellite in late 1991 or early 1992.

The balance of power among video programmers could shift considerably with the entry of yet another player. Phone companies are eager to provide television service over their digital fiber-optic networks. Right now, they are barred from doing so. But if legal restrictions are lifted, phone lines will be able to carry higher-definition images than any other medium.

Seemingly, the various segments of the television industry could not go their own way without incurring great risk, both for themselves and for HDTV as a whole. No one would buy three different TV sets to accommodate three different signal sources. Either a single medium—and a single standard—would find favor, or all the high-definition media would flop.

William F. Schreiber, head of MIT's Advanced Tele-

**THERE IS NO GUARANTEE
THAT ALL PROGRAMMING INDUSTRIES
WILL RALLY BEHIND A SINGLE
TV STANDARD.**

vision Research Program, appears to have found a way around this problem. Schreiber, who is developing a couple of high-definition formats himself (a transitional system based on NTSC and a simulcast full-HDTV system), has started shaking up electronics circles with his open-

architecture receiver concept. The OAR incorporates digital signal processing and computer technology to create a programmable TV set. Not only can it decode signals in different formats from broadcast, cable, DBS, VCRs, and digital optical fiber or discs, but it can also be interfaced with computers, video games, electronic still cameras, people meters for gauging program ratings, and other devices not yet imagined.

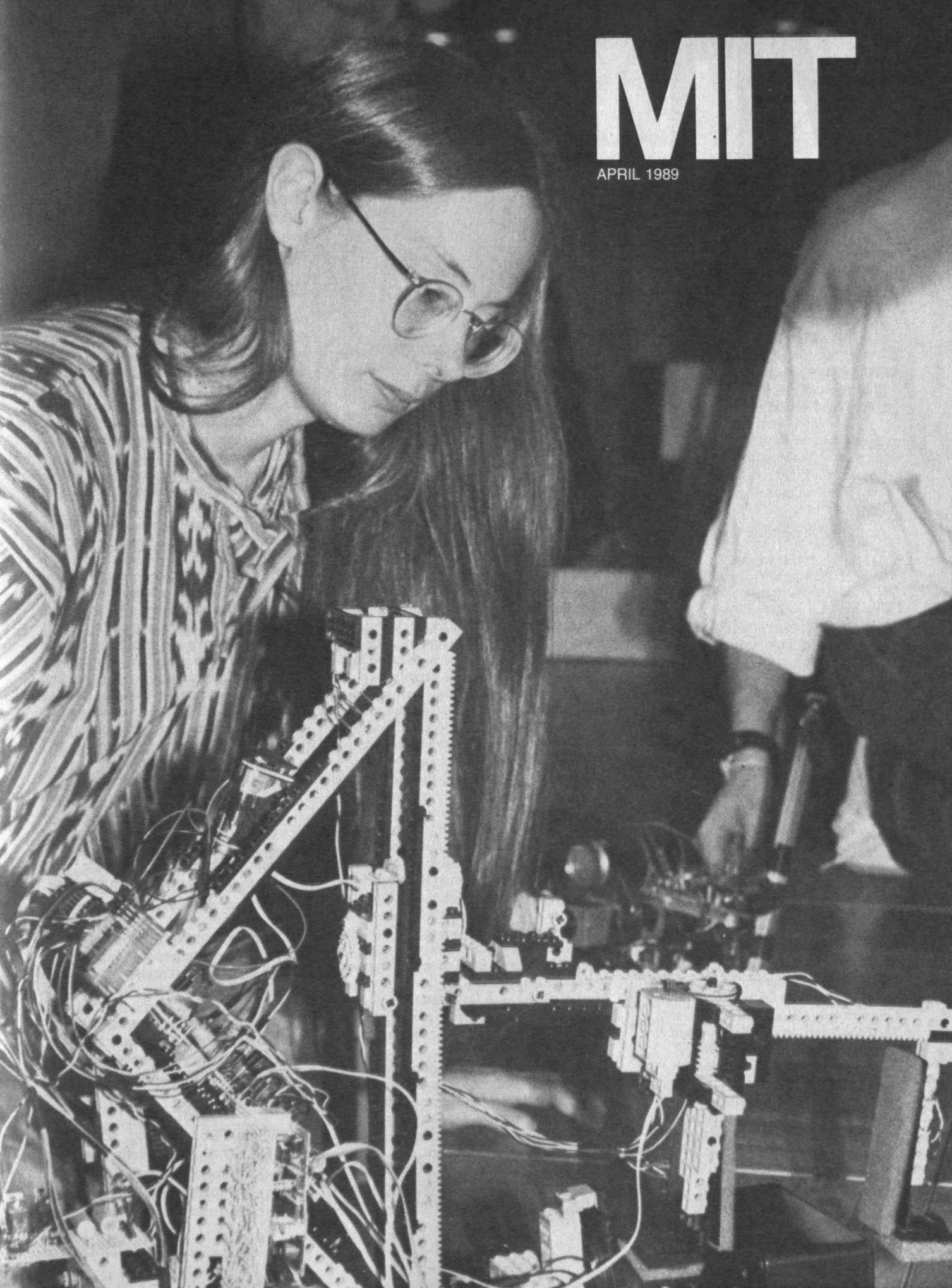
The OAR's computation section—located between the input and the display—includes a bus structure like that used in a personal computer for adding hardware and software. The bus holds electronic cards that can be installed for specialized functions such as image enhancement, freeze frames, viewer-controlled zoom and pan, or other features. Plug-in modules will also allow gradual improvements in picture quality as technology evolves.

If Schreiber's concept takes off—as it might well, since DARPA and several computer firms are interested in developing it—it will give the FCC and the television industry new flexibility in setting standards. Instead of a single standard that caters to the lowest common denominator of picture quality, the industry will be able to create a family of standards that serve all television media and all viewers.

Just as important, the OAR would boost the United States' chances of playing a major role in high-definition television. The system capitalizes on a particular U.S. strength: computer technology. Large foreign-owned TV manufacturers, accustomed to making relatively simple sets, might have trouble adjusting to a computer-driven market. Yet American hardware and software companies could find niches providing a steady flow of microchips, add-ons, and peripherals for the open-architecture receiver. By no coincidence, HDTV proponents such as North American Philips, RCA, and Matsushita are dead set against the idea. ■

MIT

APRIL 1989



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PART IV: THE HACKERS ARE STILL AHEAD

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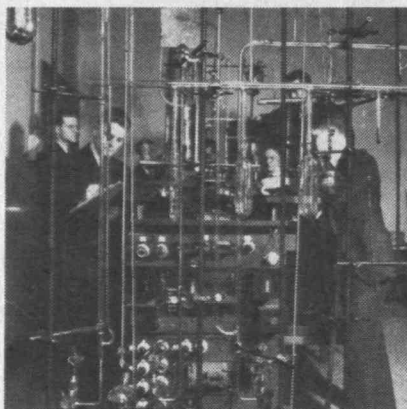
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THE FRUSTRATIONS OF A CHEMICAL ENGINEER

Since I decided to become a chemical engineer, my emotions toward the pursuit have ranged from excitement to frustration. If it were not for the inspirational success stories of engineers like Ralph Landau, Sc D'41, I would have given up on the field altogether. Your article on the Course X Centennial (*January 1989, page MIT 8*) brings back a sense of pride that I thought had long since vanished.

Like Professor Emeritus Herman Meissner, '29, I thoroughly enjoyed chemical experiments as a child and looked to Course X as a way to channel my excitement into a satisfying career. But as a graduating engineer, I could not find challenges to equal those of my adolescent experiments.

I have two vivid memories of recruiting. In an interview with IBM, I received a 25-minute lecture on the fabrication of silicon wafers and how chemical engineers were relegated to cleaning the wastewater generated by the process. With five minutes left, the interviewer asked me if I had any questions. I laughed and left. Another memorable episode went like this: "As an entry-level chemical engineer, you'll be responsible for this 50-foot section of pipe . . . in Louisiana." In such an environment, it shouldn't be surprising that I hope to find a more challenging position in management.

Chemical engineers suffer from a poor self-image. While society blames us for everything from pollution to fashionless synthetic fibers, we also face the reality of a decaying smokestack industry that lacks entrepreneurial excitement.

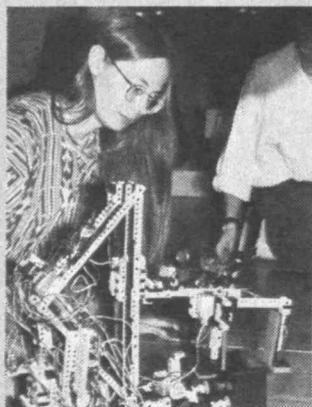
I agree with Professor of Chemical Engineering James Wei, ScD '55, and Dean of Engineering Gerald Wilson, '61, that the

MIT engineering curriculum needs expansion. Perhaps with higher levels of education will come increased challenges for MIT graduates.

However, the notion of increasing the MIT engineering education to five years is a myopic, short-term solution. MIT experiences the consequences of the pathetic American secondary-school system. One symptom is that a European bachelor's degree in engineering is considered the equivalent of a master's degree in the United States. I believe that is because European universities do not have to waste time on remedial, non-technical topics such as languages. While such subjects are, indeed, critical to a balanced education, European students master them before entering university.

My personal case demonstrates this issue. I found that my first year at MIT repeated much of what I learned in high school, and I was able to complete my degree requirements one term early. That left two and a half years in which I concentrated on chemical engineering. Think what I might have accomplished if I had been enrolled in a program that really engaged me in chemical engineering for four years. MIT's curriculum could be dramatically expanded if the American secondary school system were brought up to par and the remedial classes were dropped. MIT is too expensive to be remedial.

ANDREW GENGOS, '86
Venice, Calif.



COVER

Marty Hiller, '87, tends to her robot at the MIT Artificial Intelligence Laboratory's "Robot Talent Show." The robot was originally designed to pick up objects and drop them off the side of a desk. Unfortunately, Hiller learned on the night of the show, the only objects that were light enough for the robot to lift up were not heavy enough to activate its sensors. See page MIT 10 for more automaton talent. (Photo: Simson L. Garfinkel)

TECHNOLOGY REVIEW

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Spying Kits for Kids

In a popular song Paul Simon tells us that "these are the days of miracle and wonder." Surely this is so for the lucky child who faces a cornucopia of computer and other electronic toys this year. But among the games and educational tools is one category that should give us pause: spy toys.

In one catalogue, under the heading "Toys to Grow On," for \$19.95 you can have Super Ears, which "help you detect even the slightest sounds! Slip on the headset and aim the dish; even if your target is far away, you'll hear every rustle, every footstep, every breath, and every word!" Another stethoscope-like device permits you to hear "quiet breathing, through a

concrete wall a foot thick" and with "fidelity good enough to record." And for only a few dollars, stockings can be stuffed with a Dyna-Mike Transmitter; smaller than a quarter, it "will transmit every sound in a room to an FM radio tuned to the proper frequency" up to two miles away. Consider, too, the possibilities of voice-activated miniature tape recorders that can be slipped into a pocket or drawer, or under the bed.

In the wonderful world of advertising, eavesdropping is defined as a game, and spying on others is portrayed as fun and exciting. Sellers argue that such toys are also educational in introducing children to the mysteries of sound, hearing, and electricity, not to mention the practical skills being developed.

In addition to listening to sounds in the woods and to playmates, older brothers and sisters and even mommy and daddy can be secretly spied on. Imagine the fun! Think of the implications for the family power structure. Children are now offered technical means of watching their parents, as well as the reverse. Children's rights take on new meaning. As an added benefit, adults may behave better at home, both because they want to set a good example for curious children and because they fear being exposed by them.

Such "toys" directly feed childhood fantasies of omnipotence. While not the same as being Superman and able to fly, it is magical to be able to overhear conversa-



tions through a wall or from several hundred yards away, or to secretly capture sound and play it back.

But it can also be wrong. To encourage children to play at such activities without at the same time instructing them in the immorality of invasive information technology is irresponsible.

Defenders of toy guns argue that their products are just make-believe and are harmless because they don't really work. Children can indulge their violent or protective fantasies without doing any immediate harm or confusing their game with reality. But this is not the case with many of the surveillance devices. They are attractive because they really *do* work. Children are no longer required even to pretend or to fantasize.

In becoming accustomed to such toys and the pleasures they bring, the seeds of an amoral and suspicious adulthood are unwittingly being cultivated.

There are parallels to computer hackers. How many of the growing number of young computer criminals have simply carried over into their adult life a juvenile game view of computer hacking, in which morality is irrelevant and all that matters is the technical challenge? Will private bugging, wiretapping, and video surveillance expand as a generation matures having had these devices as childhood toys?

Children are also learning about the world of surveillance from the many child-monitoring devices marketed for parents:

transmitters clipped to a child's clothing or put into a shoe that trigger an alarm on a parental monitor if the child strays out of the signal-range area; wide-area room-scanning by remote video; audio devices in children's bedrooms; at-home urine tests for drugs. What must the world look like to the child subjected to these devices and simultaneously given spy toys to play with?

At holiday time in a free-market economy, it would probably be subversive or worse to suggest that toys be banned on the basis of the bad moral message that they send, rather than on the basis of the physical damage that they can do. Yet in the long run the latter may be

even more costly because it is insidious and its effects subtle and long-lasting.

One would hope that parents would favor toys that build trust and cooperation, or that are at least neutral in the moral lessons that they bring, rather than those that encourage spying and deception. Children's and consumer advocacy groups might oppose surveillance toys as well as toys of violence. At a minimum there should be warning labels on such listening devices indicating that their use in certain ways is illegal. The toys should also come with guidelines for appropriate use and instructional materials to help parents discuss with children the moral issues around surreptitious listening and recording.

In his novel *It Can't Happen Here*, Sinclair Lewis warned that if liberty ever were undermined in the United States, it would be from within and would occur gradually, even benignly. He didn't have such toys in mind, but they nicely illustrate his point. □

GARY MARX is a professor of urban studies and planning at MIT and author of *Undercover: Police Surveillance in America*, published in 1988 by the University of California Press. This op-ed article appeared Christmas Day in the Los Angeles Times and is reprinted here with the author's permission.



The HACKERS are still ahead

BY SIMSON L. GARFINKEL, '87

I-Ching Wu, a sophomore in chemical engineering, is taking an expository writing course which meets in Project Athena's "electronic classroom." On the desk in front of her is a \$10,000 Athena workstation on which she does all the work for this subject. Every student in the classroom is similarly equipped.

Students use the network to send copies of their assignments to each other and to the instructor, who can insert comments and criticism directly into the documents and electronically return them to the authors. From the instructor's workstation, student essays can be projected onto a large screen for the entire class to read and discuss.

Wu is skilled in using Athena's editor, text formatter, and the special programs she must use to send and retrieve her essays. But when she writes assignments for her other classes, she prefers to use an IBM/PC that she shares with a friend in her dorm.

Wu complains that Athena workstations take a long time to start up, and that occasionally it is impossible to use the system at all because of problems with the network. But her real fear is spending hours typing in a paper and then being unable to save it because of problems beyond her control—network failures and file server crashes. Her fears came true once, she says, costing her a night's work. Next semester, Wu says, "I think I will use a PC

SIMSON L. GARFINKEL is a freelance writer based in Cambridge, Mass.



“If you really know what you are doing, your files will be saved someplace.”

BRETT MASTERS, '91

... If something goes wrong, I can deal with it. ... I don't like to take chances."

Brett Masters, '91, on the other hand, often works in the electronic classroom for hours after the writing class has ended. On a typical afternoon he alternates his attention between reading electronic mail

and writing a program to solve a homework problem for Unified Engineering. He uses Athena for all of his subjects because he finds the system to be fast, powerful, and reliable. "You can't lose things," he says. Even if the system crashes, "if you really, really know what you are doing, [the file] will be saved someplace."

Lose a night's work or never lose anything? Who's got it straight? Both, as it turns out. How well Athena works depends to some extent on what you know ... or who you know. Masters says that he is comfortable with Athena not because he is a master hacker himself, but because he has friends who help him. One in particular is a fraternity brother who works for Athena. "He did all kinds of things to my account," Masters says, setting it up so it would be easier to use and so files would automatically be saved.

Athena does have a backup system. However, the backup system is designed to restore not individual files but whole disks, in situations like a disk crash or a fire, according to Jeffrey Schiller, '79, Athena's former manager of operations. "It is usually easier for a user to retype a file than for us to get it off the backup tapes," Schiller says.

When people come to Schiller crying that they have accidentally deleted their theses, the staff often makes the effort to retrieve it. But in an environment of limited resources, Athena hasn't the staff to retrieve documents for everybody, certainly not in the time frame most students need. At least, that's the story for Athena's

user community. Those on Athena's staff with access to the backup tapes could salvage their own work or that of their confreres. Although Athena is designing a new backup system that is more oriented toward serving user needs, Schiller says, it isn't a top priority.

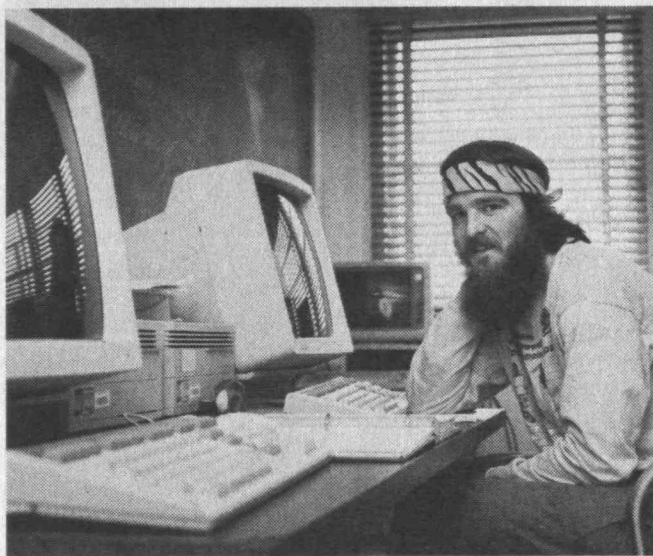
To Steven R. Lerman, '72, Athena's first director, the wide range of student reactions to Athena is quite understandable. "It's a story of diversity," Lerman says. "The students have a wide range of needs, requirements . . . and financial resources. It's unlikely that one system could accommodate them all."

One of Athena's objectives, according to Dean of Engineering Gerald Wilson, '61, was to minimize the effort students would have to invest in just learning to use the system—freeing them to concentrate on the educational subject matter. But in fact, after nearly six years of existence, Project Athena has not been successful in leveling the differences between hackers and the students who are less facile with computers. In order to survive in the complicated workstation environment that the project has created, users find it difficult to remain "computer naive."

Most students, says Dave Custer, '83, the teaching assistant for the writing course, "get burned once or twice. Then there are a couple of options: you can stop using Athena because it eats your file every couple of weeks, or you can [learn more about the system]."

How willing MIT students are to invest time in Athena depends in part on what their options are. One popular alternative seems to be the Apple Macintosh, which students can buy at the MIT Microcomputer Center at discounts of up to 36 percent off list price. In many ways, the easy-to-use Mac fulfills Wilson's requirements more than Athena.

Todd Ogawa, '87, now a medical student at the University of Colorado, bought his Macintosh in September 1984. He couldn't use Athena at the time because it was only open to students in special subjects, and he wasn't enrolled in any of them. By the time Athena made accounts available to all



"You can stop using Athena because it eats your file every couple of weeks, or you can learn more about the system."

GRADUATE STUDENT
DAVE CUSTER, '83

students in March 1985, Ogawa was a confirmed Mac fan.

"I felt that the Macintosh was a lot more user friendly," Ogawa says. "I couldn't do lab reports and stuff with Athena very easily. I didn't know how to use any of the software, and I got the impression that it was harder to learn than the Mac."

It's just as well Ogawa wasn't interested in Athena; he might not have been able to get near it much before he graduated. Project Athena opened its first cluster for general student use on March 19, 1985—three months late. It was heralded by a four-page advertisement in *The Tech* that encouraged students to use the Student Center cluster for writing papers, sending mail, and playing games. Demand quickly escalated as Athena expanded its staff of student consultants to answer questions and offered a series of "mini-courses" that would give students a jump start on mastering the system.

The most important thing about the Student Center, says Toby Sanders, '89, has been its availability. "Athena is awesome," she says, "because it's open 24 hours. You can't expect hackers to stop and close up." Indeed, when Schiller closed the clusters

over one spring break in response to a string of equipment thefts, the students voted him Alpha Phi Omega's Big Screw award.

But the Student Center, which had more terminals than any other cluster on campus, had only five time-sharing computers. It was, in the words of Andrew S. Gerber, '87, who worked there as an Athena consultant, "the pits. It was plagued by very high loads and people playing games to all hours of the night." To make a bad situation worse, accounts in the Student Center cluster were originally given only 250 kilobytes of disk storage—less space than is on a single PC floppy disk. That space was eventually increased to 600 kilobytes. (New equipment that should allow the Project to increase student file space to at least three megabytes may not be on line until fall 1989 or later.)

Of course, not all students were limited to accounts in the Student Center. Between 1984 and 1987, an increasing number

were enrolled in classes that used Project Athena for assignments. These students were given accounts in other, less crowded clusters, with correspondingly higher allocations for disk storage. Then there was a small group of students who were able to get friends who worked for Athena to build them accounts in other clusters.

Likewise, Gerber says, there were the students like Ogawa who could afford to purchase their own computers, and others who had access to word processing or other computer resources through their part-time jobs. Harold A. Stern, '87, for example, an editor of the student newspaper, wrote his essays on *The Tech's* typesetter during off hours.

In essence, says Gerber, the early years of Athena saw the development of a "caste system" among students, in terms of the computing power and convenience to which each had access.

In the spring and summer of 1987, relief seemed to be at hand. Project Athena replaced the terminals all over campus with high-performance workstations—solving the problem of high loads and sluggish response time by giving each user a dedicated computer—and opened all

clusters to all students. But use of the system has continued to climb, and crowding in the clusters has actually increased with time. Indeed, by the end of the 1988 fall term, clusters all over campus were as crowded as the Student Center had ever been.

"I can't tell you what the exact availability of workstations is at this time," said Director of Athena Earl Murman in December 1988. "We don't monitor that on a daily basis. We did note that early in the semester, some of the more frequently used clusters, like the Student Center and Buildings 11, 4, and 66, had all of their seats taken in the after-dinner hours."

By the end of the fall 1988 term, there were days that every workstation in a cluster would be in use at 5 am—still occupied by students who had been there from the night before. In recent surveys, 92 percent of MIT undergraduates report having used an Athena workstation at least once; at least 25 percent used a workstation every single day during the last two weeks of the 1988 spring semester.

To ease the overcrowding, says Murman, Athena plans to install 20 more workstations in the Student Center, a new cluster of workstations in the Hayden Library, and groups of two or three workstations wherever he can find the space around the Institute.

If there is a positive side to overcrowding, it is as a measurement of Athena's popularity: If students will stand in lines to use computers that offer less storage per user than a floppy disk, Athena must be doing something right.

Next to word processing and solving problem sets, the third most popular use of Project Athena is electronic mail. At pika, an independent living group with an Athena cluster in its basement, students use e-mail to keep in touch with alumni who have moved across town and across the country. And Dan Schmidt, '91, is one of a growing number of students who use Athena to write home—his mother works at a university and his father works for Digital, and both have access to computer networks that are linked to Athena.

Another attraction of Athena is games.



"Athena had an enormous communication problem. I think it missed an opportunity to listen."

ATHENA STAFF MEMBER
KAREN COHEN

Although Athena's 1988 survey found that students average only half an hour a week playing games, walking through a cluster or speaking with students suggests far more. "I'd say that a third of the usage is playing games," says Mark Kantrowitz, a senior majoring in mathematics and philosophy. "Every time I go up [to the Student Center cluster] looking for a terminal, I see people playing games."

Mark Eichin, '88, a former Athena systems programmer, believes that the amount of game playing is significant, but his estimate is more like 10 percent. "I would say that half of the use is word processing. What's left is split among reading news and electronic mail, course work, and games," Eichin says.

Many of those games take special advantage of Athena's high-performance graphics and network. Games like "X-tank" and "X-trek" let students at different workstations command tanks or starships, fire missiles at each other as fast as they can hit the buttons on their mice, and watch the results on their graphics displays. For the less belligerent, a game called "mboggle" lets students compete with each other in a fast-paced word

game. Athena has even set up a special file server that stores games for use from any workstation.

Although game players are supposed to vacate their workstations when there are other students who want to do serious work, few students are willing to bump somebody off the system. "You would have to be really obnoxious to do that," Kantrowitz says.

Out of Athena's original \$70 million budget, \$50 million was allocated for equipment. The rest was divided equally between system development and curriculum development projects. "That's really a sizable amount of money," notes Earl Murman. "We had more proposals [for curricular development] than we could fund, but in general [money] was not a problem."

In the past few years, dozens of those individual proposals have become programs that students now use daily. The most successful have been special-purpose calculation

and simulation programs, which let students solve traditional problems faster than they ever could without a computer.

In the undergraduate chemistry laboratory, for example, a task that used to average two nights of work now takes 20 minutes on the computer. In aeronautics and astronautics, a program called Clascron has shaved weeks off the teaching of classical control theory. And last fall, 564 students in a class on differential equations used a program on Athena to graph equations in seconds that would have taken them half an hour or more to do by hand. What's more, says Dan Schmidt, watching the computer graphing the equations is actually fun—something of a revolution in the study of mathematics, surely.

As a result of these dramatic reductions in time, teachers say, it is possible to assign problem sets that are oriented more toward design and creative thought, and less toward running numbers through a calculator. Students claim that speed enables them to learn a subject more thoroughly because they have the time to study more examples.

But is faster always better? Margaret

MacVicar, '65, dean for undergraduate education, has a note of caution: "It depends on what the results of 'faster' are," she says. "Faster often hides the assumptions and the guts. By hiding the guts of the calculation, [the computer encourages you] to believe what the program tells you, even if it isn't correct."

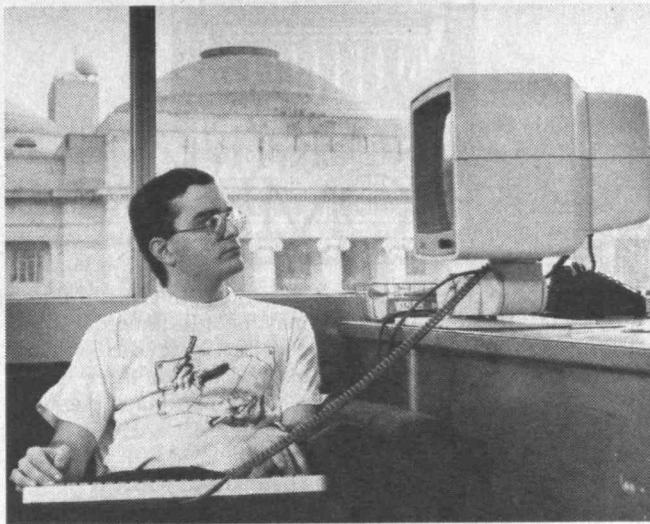
MacVicar worries about damages to the learning process when students use computers for their calculations. She cites the example of a student who uses a calculator instead of looking up trigonometric functions in tables. With tables, she says, "you see the values before the number being looked up and after. It is impossible not to notice how nonlinear the function is. The tables give the engineer a feeling for the function in a way that a calculator button marked 'SIN' simply can't."

And some subjects, MacVicar says, simply require a lot of time to absorb. "One must marinate in a subject," she says. Teaching a subject quickly by using Athena could be robbing students of that seasoning.

Samuel J. Keyser, MIT's associate provost, is similarly concerned when students are encouraged to rely too heavily on a computer program. "Every program is defective," he says. "We must develop our intuition about how the world really works. And that requires dependence on our own brains, not on some subset of our brains that has been programmed into the nearest PC."

For all of the anecdotal accounts, actually measuring Project Athena's impact on undergraduate education is difficult. For Athena's first five years, staff member Karen Cohen was in charge of surveying student response to the Project, but her questionnaires were confined to patterns of usage. Cohen says that Steven Lerman ruled out questioning students or individual faculty members about how well they thought students were learning the material in particular Athena-supported subjects.

"We didn't want to put Athena into the position of evaluating faculty performance. That isn't what we were there to do," Lerman said.



"Every time I go to the Student Center cluster, I see people playing games like 'X-trek,' 'X-tank,' and 'mboggle.'"

MARK KANTROWITZ, '89

Unfortunately, by insisting that any real attempt to measure the impact of Athena machines and software in particular subjects would amount to evaluating the teachers of those subjects, the Project hobbled its own attempts to document its value. "I don't think faculty would have minded filling out a questionnaire," Cohen says, but even that was forbidden. "[Athena had] an enormous communication problem. I think it was a missed opportunity to listen."

Lerman denies that he forbade simple surveys; he just didn't think they would find anything useful. "I was very skeptical that we would get anything by sending out surveys. . . . We had enough trouble getting the faculty to describe their projects!" Athena did conduct some informal studies, he says; they were confidential, intended solely for the information of faculty members themselves.

Sometime within the next two years, Provost John Deutch, '61, plans to appoint a committee consisting of faculty and staff—and possibly students to assess the impact that Project Athena has had at MIT. "The committee will be charged with reviewing the evaluations

that have already been undertaken of the Athena Project—its achievements, its deficiencies, and most important, its future potential—and structuring a set of options for how we might proceed," Deutch says.

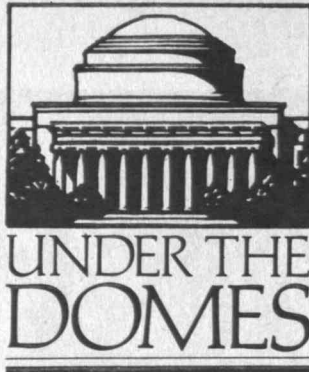
"There is no doubt in my mind that we will have to provide access to computation, communication, and word processing for our students after [the conclusion of the experimental phase of] Athena," Deutch says.

But just what form that "access" might take is still anyone's guess. Athena might continue in its present form. Alternatively, it may be broken up into MIT's departments and administrative structure and offered on a fee-for-service basis. Already, operations that have been thought of as part of Athena—including the network, the mail system, and the Kerberos Authentication System—are operated by MIT's Office of Telecommunications.

Within two years, says George Champine, who heads

Digital Equipment's five-member team at Project Athena, a workstation capable of running the Athena operating system might cost less than \$2,500. Students may be asked to purchase their own hardware and plug it into the campus network. Alternatively, the cost of that hardware might be factored into tuition. The beauty of Project Athena's technical accomplishment is that it supports a multi-vendor environment—the workstations that students purchase need not be manufactured by IBM or Digital.

Deutch estimates that the cost of maintaining Athena in something like its present state might run as high as \$6 million per year. Such a high cost, agrees Gerald Wilson, will not be accepted by the faculty unless they are convinced the system is of educational value. If the primary use of the system is for word processing, Wilson believes, MIT doesn't need a campus-wide network of high-performance workstations. For Athena to earn its keep in the years ahead, it is going to have to demonstrate that its subject-specific software and clusters of workstations have a significant positive impact on the MIT educational experience. □



USSR Academy Honors Two From MIT

Two MIT professors were elected foreign members of the USSR Academy of Sciences in December—an honor accorded thus far to fewer than a dozen Americans, including one other MIT faculty member. The new academy members are Samuel C.C. Ting, the Thomas Dudley Cabot Institute Professor of Physics and Professor Edward N. Lorenz, ScD '48, of the Department of Earth, Atmospheric, and Planetary Sciences. They join Institute Professor Emeritus Victor F. Weisskopf on that distinguished roster.

Ting shared the Nobel Prize for Physics in 1976 with Stanford's Burton Richter for the independent discovery of the fourth, or "charmed," quark. Since 1982 he has been the scientific leader of what is considered the largest international cooperative effort in high-energy particle physics. Coordinated through MIT's Laboratory for Nuclear Science, construction of the \$200 million L3 particle detector at CERN in Switzerland is the first collaboration between Europe, the Soviet Union, the United States, and the People's Republic of China. Some 400 physicists and 1,000 engineers are supporting this quest for evidence of the fundamental "Higgs boson"—an even more fundamental entity than quarks and perhaps the key

to the origin of the different masses of fundamental particles.

Lorenz, who has been at MIT since completing a doctorate in meteorology, was cited by the Soviets for his scientific merits in the field of geophysical hydrodynamics. He introduced the concept of available potential energy, which has since become one of the quantities regularly evaluated in general atmospheric circulation studies. In the early 1960s, Lorenz was the first to recognize what is now called chaotic behavior in the equations of atmospheric modeling. From

this comes the theory that it may be fundamentally impossible to predict weather beyond two or three weeks with any reasonable degree of accuracy. □

Distinctions—Part II

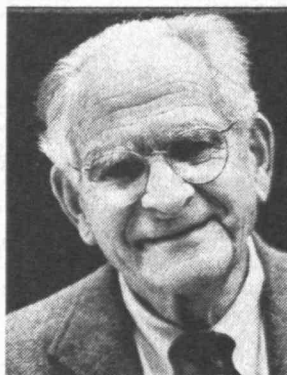
■ Institute Professor Emeritus Victor Weisskopf, the only previous MIT faculty member to be elected to the USSR Academy, has been honored anew: he is one of two physicists to win the 1988 Enrico Fermi Award for his contributions to particle and nuclear physics. The other winner is Richard B. Setlow, a biophysi-

cist at Brookhaven National Laboratory.

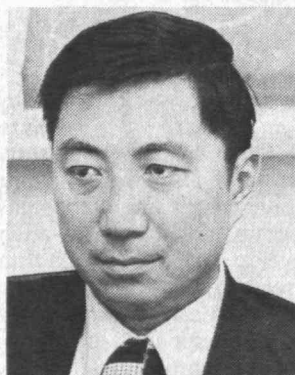
The Fermi Award, which is the highest scientific award given by the U.S. Department of Energy, includes a presidential citation, a gold medal, and a \$100,000 honorarium for each recipient. Weisskopf, called by the DOE one of the most distinguished living physicists, is widely known for his theoretical work in quantum electrodynamics, the structure of the atomic nucleus, and elementary particle physics.

■ John S. Waugh, the Arthur Amos Noyes Professor of Chemistry at MIT, has been appointed Institute Professor—a title reserved for scholars of special distinction. Waugh is an authority on chemical physics and is internationally known for his work in nuclear magnetic resonance (NMR). In NMR the magnetic moments of atomic nuclei are stimulated with static and radiofrequency magnetic fields and give rise to signals useful in a variety of applications—from medical and other imaging to spectroscopy. Waugh's theory of coherent averaging unified the understanding of many documented phenomena in NMR and also provided the conceptual base for the discovery of a variety of new ones. He has taught at MIT since 1953.

■ Two MIT students were among the 30 nationwide selected for Marshall Scholarships, which provide up to three years of all-expenses-paid study at any British university. Parag G. Patil, '89 (Course VI) will study



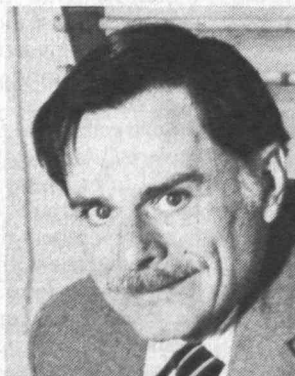
V.F. Weisskopf



S.C. Ting



E.N. Lorenz



J.S. Waugh

philosophy, politics, and economics at Oxford University, and plans to pursue an MD/PhD program in bioengineering when he returns from England. Hasan F. Naqvi, a second-year medical student in the Harvard/MIT Division of Health Sciences and Technology, plans to study the British health care system at the University of Cambridge, and hopes eventually to work in health care for Third World countries. More than 700 students from around the country applied for Marshall Scholarships, which were established in 1953 by the British government to thank the United States for post-World War II financial support through the Marshall Plan. □

MIT Faces Deficit for Fiscal 1989

After a five-year period of running slight surpluses in operations, MIT could be left with a deficit approaching \$6 million on a total budget of close to \$1 billion when fiscal 1989 closes on June 30. In figures released by James J. Culliton, vice-president for financial operations, the deficit is projected to continue into fiscal 1990 (estimated at \$1.4 million) before deficit control measures and unrestricted *Campaign for the future* revenues put MIT back in a surplus situation.

Culliton says the budget reflects the fact that research revenues are rising more slowly than in the past and that salary increases have been unexpectedly high—particularly for faculty—to keep MIT competitive. As well, there have been sub-

stantial increases in employee benefit costs such as health care and an increased demand for unrestricted funds for undergraduate student financial aid. These trends are not likely to change in the foreseeable future.

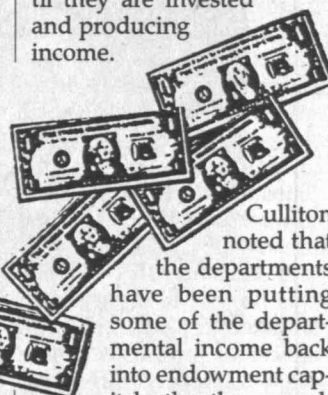
The writing on the wall was visible more than a year ago, Culliton says, and the Academic Council (president, provost, deans, and laboratory heads) began meeting in May 1988 to plan a cost-containment strategy. Among the measures to be pursued: MIT will provide smaller salary increases in the next few rounds of salary reviews, and tuition, up by

7.2 percent to \$13,400 this year, will climb again for 1989-90.

MIT's self-help limit (the amount of money each student is expected to provide through summer earnings, a term-time job, or loans) has been set at \$4900 per year for four years. Though that also is expected to rise next year, MIT remains committed to need-blind admissions, Culliton says. He noted that 180 students who entered MIT in 1988 came from families with income of less than \$20,000 per year.

The obvious question is how MIT could show a deficit when it has been running a successful capital campaign for more than two years. The answer is complex, says MIT Vice-President and Treasurer Glenn Strehle, '58. First, much of the campaign's success is still measured in pledges—future gifts. The volume of outstanding pledges went from a pre-campaign level of less than \$20 million to a present level

of more than \$90 million, he reports. Further, much of the campaign revenue is restricted to a specific department or project and cannot be used to cover general operating expenses. And campaign gifts targeted for general endowment obviously will not have an impact on the budget until they are invested and producing income.



Culliton noted that the departments have been putting some of the departmental income back into endowment capital rather than spending it. That is a good strategy for long-term Institute financial strength, but it doesn't help the current operating crunch.

"I'm very pleased with the steps taken thus far in less-than-crisis mode," Culliton says, and he is confident that the deficit will actually come in under \$6 million this year. □

Admissions Study Underway

As anybody who reads the Letters column in the alumni section of *Technology Review* has noticed, admissions policy at MIT arouses intense sentiments. It is widely accepted that the students are 50 percent of what makes this place so extraordinary, and they are a major reason that the other 50 percent—the faculty—choose to teach here.

There is no universal view of admissions history: as many alumni/ae are likely to say "I'd never get in by today's standards" as are likely to say "These kids today don't work as hard as we did."

Excellence in math and science have always been necessary to get into MIT, but they are rarely sufficient. MIT also looks for a wide range of academic and personal achievements from its potential students. In recent years, stepped-up recruitment efforts have attracted larger numbers of students with diverse backgrounds and ultimately contributed to more diverse freshman classes.

Now the question of "how full is the tumbler" is being asked with increasing frequency on and off campus. If MIT is attracting more women and minority students and students who have deep interests in the humanities and other cultural areas, if they are more engaged with broad social issues than they once were, if they are admitted for reasons other than that they are the smartest math or science students in their high schools, do they have the time, the inclination, and the native ability to be the first-class technologists who have always been the sine qua non of MIT?

Some of the faculty think not. The current sentiment on the campus was brought to a head by a report compiled by Physics Professor Anthony French and circulated among many of the faculty. In reviewing the profiles of freshman classes, 1968-1987, French found evidence that the average scores on standardized tests were declining. Vague concern about the abilities of MIT students and the suitability of admission standards became more focused; the faculty agreed that it is im-

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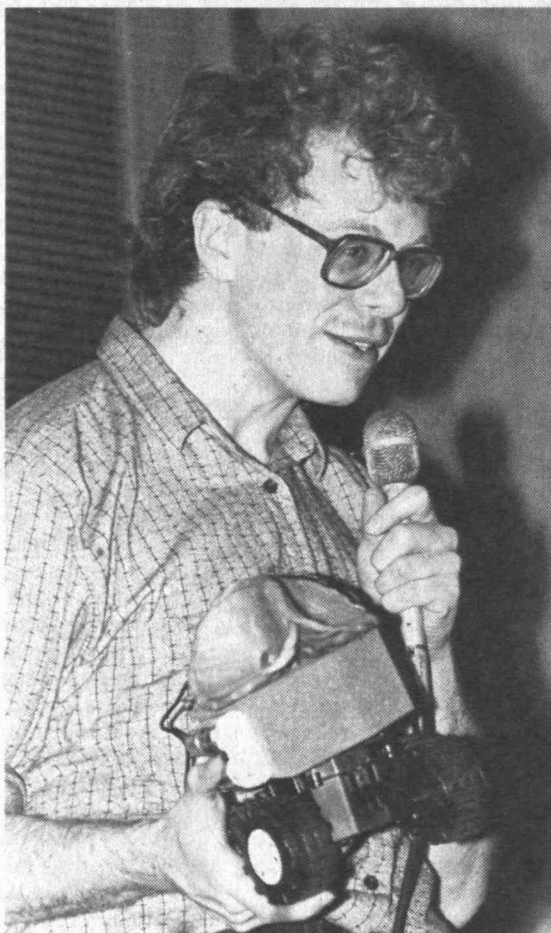
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Gregory D. Williams
Ernest V. Linek
Linda M. Buckley
Ronald I. Eisenstein
Jill M. Koster

Of Counsel
Robert T. Gammons, '33
Frederick S. Frei
Henry D. Pahl, Jr.

UNDER THE DOMES

CONTINUED



Left: Michael Travers, '86, a graduate student at the Media Lab, holds "horton," the robot he built with Ian Horswill, SM '88, a grad student at the AI Lab. Horton walks around the room looking for somebody to listen to it. When it finds someone, it does a little dance and waits for applause.

Below: The AI Lab's "Robot Talent Show" organizer Anita Flynn, '83, holds her 1.2 cubic inch entry. The robot includes a microprocessor, power supply, light sensor, and a microspeaker. It will (among other things) search out light sources and chirp; when the light is turned off, the robot runs away.



portant to understand exactly what, if anything, is happening to student performance.

So the latest of a long history of studies of admissions policy is being carried out under the aegis of the Committee on Undergraduate Admissions and Financial Aid (CUAFA), chaired by Associate Professor of Civil Engineering Keith Stolzenbach, '66. One of the first things that Stolzenbach did was to extend French's report back to 1962. Although there has been a decline since the 1967-68 (post-Sputnik) high-water mark in average scores on standardized admissions

tests in math and physics, Stolzenbach found that the average freshman in 1987 did better on standardized tests than his or her 1962 counterpart.

Since last summer, CUAFA has conducted an exhaustive survey of faculty information on student performance, tapped the knowledge of present and former admissions directors, looked at all the steps in creating admissions policy and applying it to the evaluation of individual applicants, and scoured all the sources of relevant data—going as far back as the 1950s.

At the same time, CUAFA is encouraging faculty to be

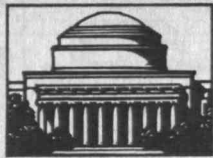
come more involved in admissions. To help the faculty understand the process, the admissions staff invited them to attend a simulation of an admissions decision session. "If I had my way," says Stolzenbach, "every faculty member would come to one of these sessions." At the same time, admissions staff are attending regular MIT classes to gain firsthand understanding of what it is that they are admitting students to.

What's more, Stolzenbach reports, CUAFA wrote to every academic department asking for the names of their "best" students of the past five years and some information on

why those students are considered the best. The committee then studied the admissions applications of those students, looking for relationships between the features that can be identified in an application and the qualities later found to be outstanding.

This impressively thorough effort will be summarized and reported to the faculty sometime this spring.

"Admissions policy is one way that MIT defines itself," Stolzenbach says, "yet there is almost no community-wide discussion of admissions issues." His committee hopes that this report will change all that.—Susan Lewis □



DomeBits

RESEARCH TEAM CLEARED

A team of scientists that includes Professor David Baltimore, '61, director of the Whitehead Institute, was cleared by the National Institutes of Health of allegations of research fraud, misconduct, manipulation of data, and serious conceptual errors. The widely publicized investigation was prompted by charges from a postdoctoral fellow that a paper describing experiments on the genetic control of the immune system printed in *Cell* magazine contained fraudulent data. The fraud charges levelled at the MIT team (most of whose members are now at other institutions) became the subject of a congressional subcommittee hearing as well, and that investigation is still underway.

The NIH report did note "significant errors of misstatement and omission, as well as lapses in scientific judgment and interlaboratory communication" and added that the "inaccuracies and clerical errors" were "serious enough" to warrant correction via a letter in *Cell*. The panel said that an earlier letter of clarification from the researchers published in November was insufficient. □

SMITING THE SMOOTS

Will a bridge too far gone spell the end of Smootmarks? Half of the measurements familiar to thousands of Boston pedestrians have already vanished, along with the entire western side of the Harvard Bridge. The decrepit MassAve span is undergoing major refurbishment, and saving the Smoots was somehow omitted from the construction contract.

A number of proposals were proffered, and the contractors indicated they'd be

happy to help as long as someone paid the bill. Casting the marks in bronze, repainting them on the new bridge using Stephen R. Smoot, '90, son of the prototypical Oliver, '62, or cutting out the remaining originals and implanting them in fresh concrete were all suggested. Some drawbacks of those suggestions were that bronze is expensive, Smoot *is* four inches taller than his dad, and the old marks have grown lethally slippery, having been lovingly repainted twice every year by members of Lambda Chi Alpha, perpetrator of the prank back in 1958.

After much debate, the Metropolitan District Commission (MDC) has agreed to let the fraternity repaint the marks on the renovated bridge. "Although we don't usually encourage the defacing of public property," said an MDC spokeswoman, "the Smoot is a longstanding tradition popular with the public at large. We'd like to see it preserved." In addition a Smoot-long section of the original concrete will be preserved at the MIT Museum, and a commemorative bronze plaque will be installed on the bridge this spring. The Lambda Chis have already marked the measurements on a quarter-mile of string—proving the viability of low tech even at

Tech—and it is now ensured that trudging perambulators will know how far they've come and police can still pinpoint fender bender locations to the nearest Smoot. □

ANOTHER KIND OF BRIDGE

While the Harvard Bridge is undergoing a major overhaul, the Harvard bridge team was overhauled by MIT at the North American Collegiate Bridge Championship sponsored by the American Collegiate Bridge League. Graduate students Daniel S. Nussbaum, '85 (Course VI), and David C. Rowntree (Course VIII) finished first with a score of 179 out of a possible 200—"a remarkable score," according to bridge writer Henry Francis, especially considering that the problems posed had a high degree of difficulty. Harvard pairs came in second and third, with another MIT pair finishing sixth. □

ROTC RELATIONSHIP REVIEWED

With an eye toward "enhancing the strengths" of the MIT/ROTC partnership and "alleviating its scratchy places," Dean for Undergraduate Education Margaret MacVicar, '65, has appointed a committee to consider ways to refresh the relationship. The group has been meeting

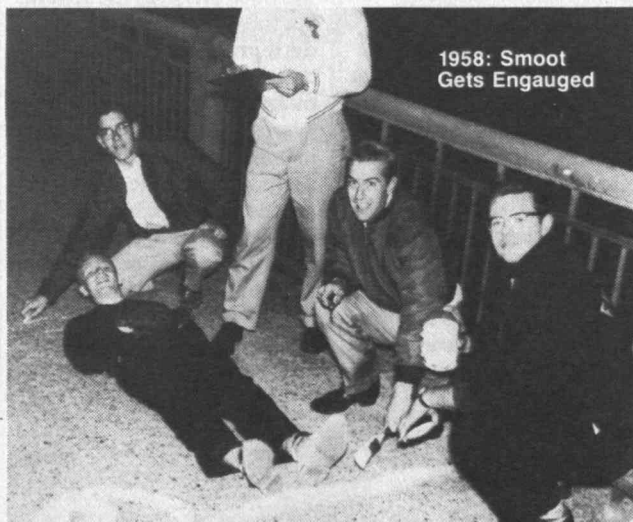
since last September to "identify issues of concern to both [MIT and the Reserve Officers Training Corps programs] . . . and is charged to resolve issues whenever possible or to recommend an appropriate path or mechanism for future action," MacVicar said.

The committee has asked for input from faculty, staff, and students on issues including AIDS testing policies, harassment of MIT students in uniform, and the fate of Building 20, which houses the ROTC offices and is scheduled to be replaced. One hundred and thirty-five students from Harvard, Tufts, and Wellesley train with the ROTC units at MIT, which has had military programs since it was founded. There are 248 MIT students in ROTC. □

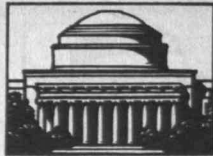
PATENTLY PROMINENT

A recent report in the British journal the *Economist* ranks MIT first in the number of patents (66) issued to American universities in 1988. Following close behind were the nine-campus University of California (60) and Stanford (56).

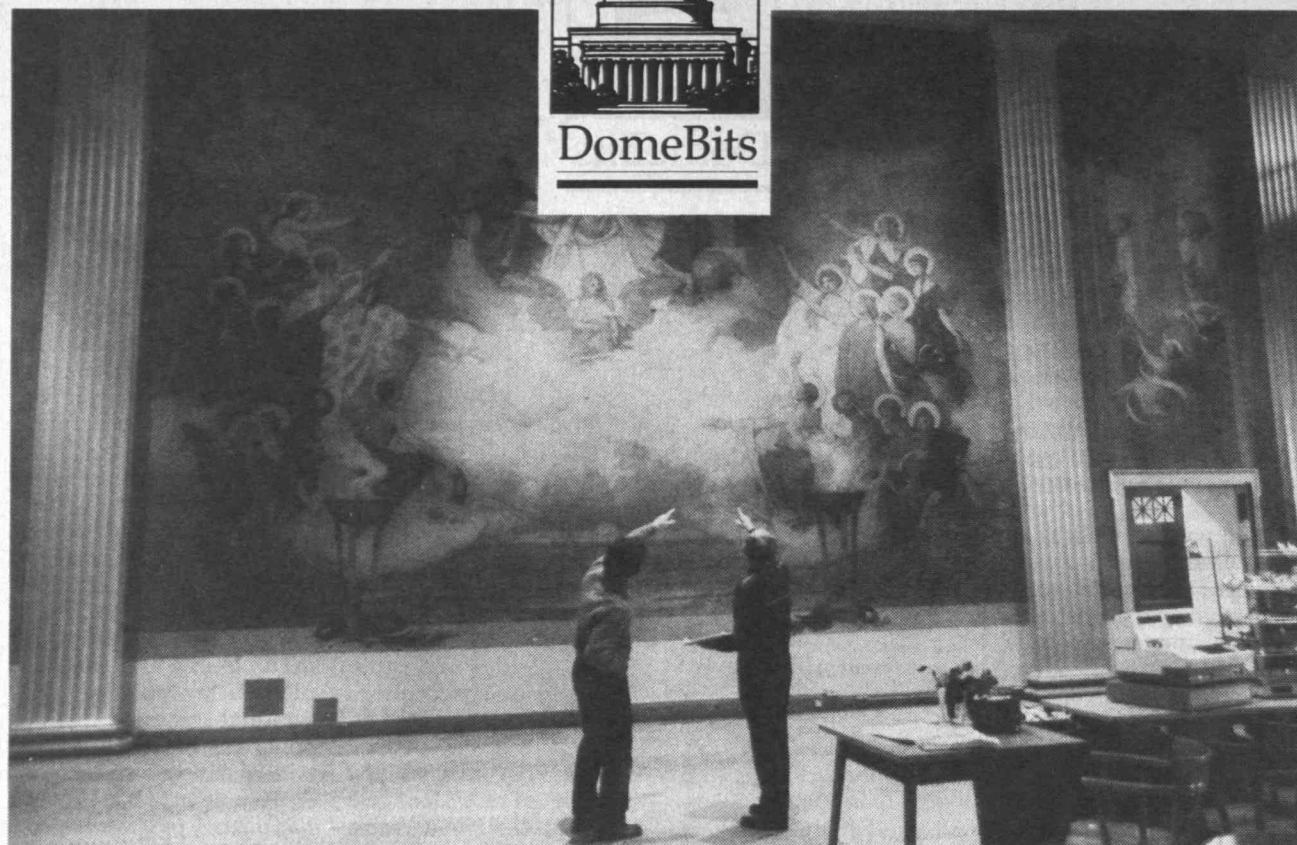
Toward the 1989 count, the U.S. Patent & Trademark Office has indicated that MIT will be issued the nation's first patent covering a fundamentally new process in high-temperature superconductivity. The patent covers an invention by Professors John B. Vander Sande and Gregory J. Yurek of the Department of Materials Science and Engineering. They developed a method of preparing a superconducting composite that overcomes the inherent brittleness of high-temperature ceramic superconductors by combining the metallic parts of same with a noble (highly resistant to oxidation and corrosion) metal such as silver, platinum, palladium, or gold. □



1958: Smoot Gets Engaged



DomeBits



EDIFICE INFO

■ **Walker Memorial:** The cafeteria murals painted by Edwin H. Blashfield, Class of 1869, have been given new life by art conservator Morton C. Bradley, who has also restored the Lincoln Memorial murals, among many others. Blashfield, who painted the scenes in 1923 and 1930, when he was almost 80, was known as the dean of American mural painters. His works adorn the Library of Congress dome, the Detroit Public Library, and the state capitols of Minnesota, Wisconsin, Iowa, and South Dakota. Cleaning the murals in Walker was made easier by the fact that Bradley had coated the canvases with an acrylic resin when he first restored them 30 years ago—so the most recent grime had not adhered directly to the paint. Bradley also was responsible for restoring more than 50 paintings by Charles H. Woodbury, 1886, whose works were recently featured in an exhibit at the MIT Museum.

■ **Green Building:** The fine for trespassing on the roof of Building 54 has increased tenfold to \$500, owing to an increase in the incidence of vandalism and large, heavy objects being thrown off the roof. In the past year, astonishingly, *no one* was hurt by the following items taking the quick way down: a refrigerator, a bicycle, a cast iron generator, a stereo receiver, and two five-gallon cans of gravel. Whereas it seems to have been worth \$50 for such a hack, a \$500 fine is hoped to prove more of a deterrence. □

MINORITIES APPRECIATE CANDOR

In 1985, MIT surveyed its black alumni and alumnae about their experiences as students. Then, with a candor not often seen in comparable circumstances, MIT made public a report that showed discriminatory behavior on the part of white students and faculty. The survey was considered an important step in improving the minority climate

at the Institute. The fact that the MIT study stands as a benchmark by which other institutions might be measured was indicated in a recent report on campus racism from the New England Board of Higher Education. Titled "Equity and Pluralism," the NEBHE report quotes extensively from the MIT document and calls on other institutions to carry out similar self-assessment (among many other measures). As reported in the *Boston Globe*, the NEBHE report found that blacks and Hispanics are the fastest-growing segment of the population in the region. Yet they are consistently underrepresented in postsecondary programs, particularly in math and science. MIT has been successful in recent years in building its minority enrollment, and Clarence Williams, special assistant to President Gray and assistant equal-opportunity officer, attributes that enrollment at least in part to MIT's willingness to examine its problems with discrimination. □

#1 IN \$\$\$\$\$\$

MIT's \$35 million in industry-sponsored research last year put the Institute first in that category, according to the National Science Foundation. The Georgia Institute of Technology ranked second with \$23.6 million in research and development funds, and Pennsylvania State University was third with \$20.1 million. □

ALL IN THE NUCLEAR FAMILY

War and Peace in the Nuclear Age, a 13-part Public Broadcasting System documentary series that began airing in January, had among its principal advisors MIT Skinner Professor of Political Economy Carl Kaysen and Jack Ruina, professor of electrical engineering and director of the Defense and Arms Control Studies Program in the Center for International Studies. The series traces the development of nuclear weapons, the evolution of nuclear strategy, "and the politics of a world with the power to destroy itself." □



ALUM. NEWS



Muhammad Elected to Corporation

Fuad U. Muhammad, PhD '87 (VIII), a physics instructor at the University of Maryland, has been elected a member of the MIT Corporation and will serve the remaining months of Karen Fulbright's term. Fulbright, PhD '85, resigned from the Corporation to accept a position in the MIT Department of Urban Studies and Planning. Muhammad will serve until June 30, 1990.

Announcement of the election was made by David S. Saxon, '41, chairman of the Corporation.

The Corporation includes five members serving five-year terms who are members of recently graduated classes and who are nominated, one each year, by vote among members of those classes. A screening committee of Corporation members, chaired this year by Arlene Frances Roane, '83, selects a slate of eligible nominees from a large list of interested individuals. The Association of MIT Alumni and Alumnae conducts the election each spring.

Muhammad received a BA in physics in 1982 from the

University of Chicago. He currently teaches elementary electricity and magnetism, waves and oscillations, and elementary thermodynamics to engineers at the University of Maryland.

He was a national Science Foundation Fellow from 1982-84, and has received several awards, including the Edward "E" Horton Award for outstanding tutor in the Black Student Union Tutorial Program and the Abram L. Harris Award as an outstanding contributor to the University of Chicago community. □

Delts Celebrate Centennial

The Beta Nu Chapter of Delta Tau Delta was established at MIT in the spring of 1889, and at least 100 Delt alumni from across the country are expected to be on hand June 2-4 to celebrate 100 years of history.

In a pre-Commencement weekend of festivities, the Delts from as far back as 1921 will mix with the newest

pledges at an outdoor barbecue and a formal dinner at the Westin Hotel. Grads from different eras will also combine sampling Boston restaurants and gathering with their contemporaries. A Sunday brunch at the chapter house on Beacon Street in Boston will cap the occasion.

The word went out late last year asking alumni to send in remembrances and mementos of their undergraduate years in the fraternity to be included in a complete chapter history. □



Even the icy beaver was included in the warm reception accorded a trio of emissaries from MIT by the MIT Alumni Association of Korea (MAAK). Last October, Corporation Chairman David S. Saxon, '41 (left), Professor of Mechanical Engineering Nam P. Suh, '59, and Assistant Dean of

Engineering Eric C. Johnson, '67, visited the Republic of Korea. Their goal was to provide background about MIT and its relationship with industry, and explore the potential for developing closer ties with Korean industry.

MAAK's president, Tae-Sup Lee, PhD '66, (center) is a member of Korea's unicameral National

Assembly, roughly equivalent to the U.S. Congress, and a former minister of science and technology as well. He, Hai-Hyung Cho, '58 (right), and other members of MAAK were instrumental in arranging meetings between the MIT contingent and cabinet ministers and senior executives.



CLASS NOTES

16

We are happy to report that **Caruthers A. "Dina" Coleman** plans to return to the New Mexico Military Institute for its 100th year celebration. Dina is their oldest living graduate, having graduated in 1911, and then coming to MIT. In May 1985, he was inducted into the Hall of Fame of New Mexico Military Institute. I hope that he wears his special hat and monocle and has the opportunity to tell a couple of his "Pierre" stories.

Unhappily, we record the death of our good friend, **Charles J. McCarthy** on October 13, 1988. He was a retired executive of United Aircraft Corp. of Hartford and Chance Vought Aircraft Inc. of Dallas. He was known internationally for his work in the design and production of aircraft for the U.S. Navy. In 1957, he was awarded the Collier Trophy for his work on the Crusader, a navy jet fighter used aboard fleet carriers during the late 1950's and 1960's. He was the former chairman of the board of the Aerospace Industry Association, and was named by President Eisenhower in 1957 to the National Advisory Committee for Aeronautics, the predecessor for NASA. In 1965, he received the National Aeronautics Elder Statesman of Aviation Award. With his wife, Betty, who predeceased him, Charlie regularly attended our reunions. We enjoyed very much sharing with both of them on those wonderful occasions.

Please write. Our ranks have thinned considerably. We need to be uplifted, and timely letters from our classmates will do the trick.—**Bob O'Brien**, Acting Secretary, 25 Keith Rd., Pocasset, MA 02559

18

As of this date I am happy to report cheerful New Years greetings in response to mine from **Charlie Taverer**, **Stuart Caldwell**, **Ben Greely**, and **Art Williams**. All regretted missing our 70th reunion—but our 75th looms ahead—can we all make it? Let us go to it.

News from the Alumni Office tells of the passing of **Al O'Donnell** on May 18, 1988—no further details.

Eli Berman is spending the winter in Coronado in southern California. He writes: "This is a resort area where one can walk barefoot for miles along the beach. For more good news, I have just been blessed with two more great grandchildren. Another one is expected in February."—**Max Seltzer**, Secretary, 865 Central Ave., Needham, MA 02192; **Leonard Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

19

70th Reunion

Our classmate **Robert MacMillian** sends a story of his annual activities to his friends each year. Recently we received a copy of the story for 1988, and find it laced with fun and flavor. It has to be seen to be fully appreciated, so I will bring it to

our 70-year reunion. Bob cannot be there, he is in his 92nd year and has eye problems.

Also, we received an interesting letter from classmate **Francis B. Weiskittel**, who plans to be at our June 1989 reunion. I will be happy to bring the letter to show to those other classmates with whom we shall meet.

We do not have any bad news to report, but rather a reference to our 70-year special reunion in 1989. We think all members of the class have been advised that the reunion will be held at the Institute on Technology Day, June 9, 1989. The Alumni Office sent a lovely card of announcement to the class in late December, while at the same time a letter was addressed to the class membership. It is further planned to have detailed and pertinent information in your hands in time for the meeting at the reunion. We hope those who plan to attend will be able to do so. Your class secretary hopes to be there to greet those who come and to remember the others in the later class notes.—**W.O. Langille**, Secretary, P.O. Box 144, Gladstone, NJ 07934, (201) 234-0690

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Cards from **Barbara** and **Bill Dewey**, **Ed Ryer** and **Frank Maconi** brightened the year for this old timer. Bill likes his present location—10950 Temple Terrace, Seminole, FL 34642. Ed made a surprise visit. He looks very well and we both enjoyed reminiscing about old times. Frank keeps active in town (Leominster) affairs. Keeps him young, he says. . . . Word from **Alan Burke's** son tells of his location at Wellesley Manor Nursing Home. His is "doing OK," says his son.

Carleton Alexander died a few months ago. He lived in Wickliffe, Ohio, for 40 years. He served in the army during World Wars I and II and was a deputy regional chief. He worked in Alaska designing and constructing structural foundations on permafrost. He was co-author of a technical handbook of Arctic engineering for the U.S. Navy. He is survived by a son and daughter, six grandchildren, and two great grandchildren. . . . **Ward Robertson** of London, England, died last August. He is survived by his wife and son.

Buzz Burroughs was thoughtful enough to send me the *Boston Herald* obituary on the death on August 9 of George Dandrow, '22. George was an asset to his class and the Institute. (See the February/March obituary section of the *Review* for further information.) . . . **George Des Marais** writes that his family keeps him young. His grandson now lives in Boston and is practicing law there. Hurray for good old George!

Wishing you all the best for 1989.—**Harold Bugbee**, Secretary, 313 Country Club Heights, Woburn, MA 01801

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I had a phone call late in November from Hugh Darden to tell me that **Helen St. Laurent** had a fall in Center Lovell, Maine, in early November and broke her hip. She first went to a local

Maine hospital, but was transferred to the Manchester Memorial Hospital as soon as it was feasible. I phoned her at the Manchester Hospital and found her very cheerful. She was using a walker and doubtless is home now.

Christmas has come and gone and with it a number of cards from classmates. Cards were received from Maxine and **Cac Clarke**, **Claudia (Mrs. Josiah) Crosby**, **Helga (Mrs. James Stewart) Parsons**, **Emma (Mrs. Leon) Lloyd**, **Ruth and Irving Jakobson**, **Dorothy (Mrs. Joseph) Wenick**, **Francis Blewer**, and **Betty (Mrs. Norman) Patton**.

Cac wrote that he had embarked on new duties as class agent (pro tem). They had a big family dinner for Thanksgiving and to celebrate their 60th wedding anniversary. Cac has concluded 20 years on the editorial staff of the *Coast Star*. . . . **Dorothy Wenick** reports painful arthritis, but works with unfortunate children even though walking is limited. . . . **Emma Lloyd** took a trip to Mexico during the year when her son-in-law, Sam Hayes, was asked to give seminars in Mexico City and Monterey.

Claudia Crosby wrote her Christmas card from Washington, D.C. Her sister fell and broke her right shoulder in late November. Claudia flew up from Florida to help and was still there. . . . **Helga Parsons** wrote that she had become an ardent patron of the North Carolina Shakespeare Festival. She says, "It's stimulating being with stage folk once again." . . . **Betty Patton** wrote, "I have a job, a paying one. I go in at 11:45 and have a happy afternoon at Triple 'S' Steel, typing, filing, and answering the phone. I took a five-day tour to Virginia Beach in May and then spent a few days on Cape Cod in August."

There are four deaths to report this month: **Philip R. Payson**, of Fort Meyers, Fla., on January 15, 1987; **John R. Driggs** of San Mateo, Calif., on April 17, 1987; **George E. Shoemaker** of Westown, Pa., on September 15, 1988; and **Whitney H. Wetherell** of N. Chatham, Mass., on October 29, 1988. I used to see Phil Payson every winter when we would have a mini-reunion in Florida. **George Shoemaker** was a graduate of both Princeton and MIT. He was a lighting consultant for the Philadelphia Electric Company for 37 years. **Whitney Wetherell** attended many of our reunions and we shall miss him.—**Sumner Hayward**, Secretary, Wellspring House E64, Wash. Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, Assistant Secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22

Could any of our classmates comment on this. I have recently learned that **William B. Elmer**, our eminent authority on reflectors, is now a Fellow in three important societies; Institute of Electrical and Electronic Engineers, Optical Society of America, and Illuminating Engineering Society. Are there any other members of our class (or any other class for that matter) who have earned equal credentials? Is it rare for a person to be elected as a Fellow in as many as three societies such as the above. Any advice will be welcome.

Horace "Mac" McCurdy whose many contributions to the welfare of crew are known to all '22ers, was further honored this last fall by the granting to him of the highest award bestowable by Friends of MIT Crew, namely, Friends of MIT Crew 1988 Founders Award. I quote from the letter of the chairman of the Friends to Mac advising him of the award. "You certainly deserve it as the Father of MIT crew and as the best 'friend' MIT crew has. The announcement was made at the annual dinner before the 170 alumni and students who attended. Your name is to be engraved on a plaque on permanent display at the boat-house. Your unflinching loyalty and dedication to rowing at MIT is an inspiration for many,—coaches, alumni, and most importantly the undergrads who see the McCurdy name in so many places at the boat-house." I think I speak for the class in saying, "Thank you, Mac, for what you have done."

In an exhibition of photographs and related material on "Women in Architecture" held recently in the Architecture Department at MIT appeared our classmate, **Marjorie Pierce**. Marjorie, at 88, must take the women's longevity architectural championship. She is already the all comers professional champ. . . . **John R. Robinson**, retired for many years and now living in Gettysburg, Pa., is "still hanging in there and keeping busy with volunteering for Red Cross, YWCA, Meals-on-Wheels and anywhere else I can be of help. Keeps me out of mischief." I suspect the above quote is closely applicable to many classmates from whom we have no word.

Chang Tsu Chien died August 8, 1988, at age 87 in Fountain Valley, Calif., after a long illness. After receiving his master's degree in '23 he returned to China to help in the development of aviation and aeronautics. At various times he served as dean and president of colleges and a of firm concerned with aviation and aircraft. During the last years of World War II he was stationed in the United States as procurement officer for the Chinese Airforce. In 1949, in Taiwan, he became Deputy Minister of Economics, secretary of the Economic Stabilization Board and vice chairman of the Foreign Exchange and Trade Control Commission. He was president of the MIT Club in China for many years. In 1971 he became chairman of the board of Mobile-China Corp. from which he retired in 1973. His retirement years were spent in Fountain Valley, Calif., writing his memoirs to record his long and distinguished service to the Chinese government. Mr. Chien is survived by his wife, Maria, of 62 years, six children, 11 grandchildren and one great-grandson. Among his grandchildren is Jeannette M. Wing, class of 1979 (S.B. and S.M.), electrical engineering and computer science) and 1983 (Ph.D. computer science). Her father, Omar Wing, Mr. Chien's son-in-law, is MIT 1952 (S.M.) electrical engineering. Miss Wing is assistant professor of computer science at Carnegie Mellon University. Her father's position in 1984, according to the 1984 Alumni Register was professor and chairman of the Department of Electrical Engineering at Columbia University. A remarkable family. Our condolences and appreciation are extended to the Chien family.—**Yardley Chittick**, Secretary, Rte. 1, Box 390, Ossipee, NH 03864

23

I am trying to get together our class column with about three "Bow!" football games on the air, and I have to turn them off. . . . However, some months ago, before I became secretary, I read in our class notes that **Robert Armstrong** passed away. I had lost track of him. He was my tent mate at the Civil Engineering Department camp in 1920 in East Machias, Maine. It was the last year tents were used, wood barracks replacing them. Toward the end of the camping period, I saw less and less of Bob, as he visited "someone" in the village. Later I found that he had married that someone. I have been wondering how many

of the campers and instructors for that period are still alive.

The Christmas mail was quite heavy, among which was a letter from **Dave Joy** recounting the past year. You may remember his wife, Meriam, fell and broke her knee cap. They had to cancel all arrangements for the 65th reunion. Meriam is much better and is getting around quite well. My wife, Winnie, received a package earlier from the Kalkers, who spend their summers in Williamstown, Mass., and winters in Florida.

Your secretary has received word of the loss of one classmate since our last column, **Stanley S. Setchell**, who died in August 1988. Stanley received his B.S. in architecture. He was a registered architect in Massachusetts and was a member of several architectural societies. He served in World War II in the navy as a lieutenant commander.

God bless everyone during 1989.—**Frederick O. A. Almqvist**, Secretary, 63 Wells Farm Dr., Wethersfield, CT 06109

25

Holiday greetings from classmates are much appreciated and several were heard from this year. From Florida came greetings from **Fred Greer** and Eleanor, **Ed Kussmaul** and Adele, and **Franklin Fricker** and Marian. Franklin notes that they have been trying to find a resort not part of a real estate development which would give a nice climate change from Naples. Last summer they spent two weeks at the Trapp Family Resort and although they found the place enjoyable there was too much hub-bub. . . . **Maxon King** and Esther wrote from California and enclosed a clipping from the December 1988 issue of the magazine *Civil Engineering* which paid honor to Dean **Morrrough O'Brien**.

Sam Spiker and Elinor sent greetings from their winter home in Brookline. Sam has volunteered to work on the 65th reunion gift and you will be hearing from him in the near future. Sam has been in touch with the Alumni headquarters and **Courtenay Worthington** regarding reunion plans. By the time you read these notes you will probably have heard from Courtenay about plans. Respond to his questions promptly. . . . From California came greetings from Lillian Drew and Charlotte Blonsky. . . . Frances Stanton who has been residing in Wellesley for several years has moved to a retirement home at 910 Boylston St., Chestnut Hill, MA 02167. There she will have meals served to her and she plans to take life easy.

Many classmates never got well acquainted with the young naval officers sent to MIT to do graduate work leading to master's degrees in naval architecture. One of this group was **Nicholas A. Draim** now Captain of the U.S. Navy, retired. You might be interested to learn about the Captain. He graduated from the U.S. Naval Academy in 1922, received his S.M. in naval architecture in 1925; attended Georgetown Law School, obtaining his LL.B. and J.D. from that school. In addition he took post graduate courses in science, engineering and languages. Captain Draim had an active and distinguished career with the navy as follows: midshipman; qualified diver and underwater welder; aviation pilot; naval architect; specialist in the design, construction, maintenance and operation of naval aircraft; naval observer; aviation materials and logistics officer, staff of Commander Fleet Aircraft, South Pacific, World War II; diplomatic senior naval attaché and naval attaché for air, American Embassy, Moscow; member of the Bar, U.S. Supreme Court; law officer, trial counsel and defense counsel, General Courts Martial, Armed Forces of the United States. He was a member of scientific and technical societies, including the American Society of Naval Engineers, the U.S. Naval Institute, Institute of the Aeronautical Sciences (associate fellow), American Bar Association, and the Mathematical Association of America.

The Captain now resides in Menno Village, Chambersburg, Pa. He writes that he is presently fighting a delaying action against the fourth horseman of the Apocalypse.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Corners Rd., P.O. Box 331, North Chatham, MA 02650

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In the Boston area, we have an organization for those out of Tech for 50 years or more called the Cardinal and Gray Society. We meet spring and fall at the Endicott Estate which was left to Tech a number of years ago. We start with a social hour, followed by a dinner. Then we have a professor speaker who helps us understand the work they do which helps the public. It is excellent. We now have a committee which is going to try to make this association available to all who have reached their 50th reunion. You would be smart to help to make this a local success and would meet classmates, and those of other classes, and enjoy yourselves.

William W. Farr writes, "Enjoyed the items in the *Review* about **Henry Jones**, my classmate at William Penn Charter and my roommate the first term, and also **Mark Greer** and **Cedric Valentine**. I was second oar in the field day crew with them. We did not do too well, almost swamped. The article on *Daedalus* was great. I have always been interested in manpowered flight." . . . **Al French, Jr.** writes, "Am very busy living in Burt Lake, Michigan—three months; Ohio—four months, Florida—6 months, and 1 month traveling. Don't believe I took a course in adding at MIT. The other courses I remember better. Glad I went to my 50th reunion, and hope another comes soon again. My best to all." . . . **Walter Lebe's** wife, Kathleen, died March 6, 1987. She was a sister of the late **Paul Mahoney**, '26. Walter writes, "I am now fully retired so am no longer in the private chemical engineering consulting business, which I practiced for 26 years."

Leonard L.F. Remington of Franklin, Mass., died October 9, 1988. He was with the Thomson National Press Co. for 50 years, general manager for 34 years. He was very active in local affairs including school committee, Boy Scouts and Rotary Club. He held top positions in these and many others, including Past Commander of the U.S. Coast Guard Auxilliary and received Rotary Man of the Year award in 1964. He was an organist and pianist with his own band. . . . **Daniel L. Bloomberg**, of Santa Barbara, Calif., died August 14, 1984, leaving his wife, Eugene. Daniel was chief engineer and technical manager of Republic Productions of Hollywood, Calif. . . . We received more material on **Robert E. Ellis**, whom we reported in the last issue. He was a member of the Moles, the University Club of New York city and served as an arbitrator for the American Arbitration Association. He was former president of the Venezuelan American Chamber of Commerce in New York. Robert moved to Ashville, N.C., in 1983. Surviving are his wife, Helga, two sons, a brother and six grandchildren.—**Donald Cunningham**, Secretary, 27 Lowell St., Braintree, MA 02184

27

As there is no class news to report this month, I am taking the space to ask a question. I have mentioned occasionally that by the foresight of previous secretaries, manila folders have been prepared for practically all members of our class. In these files are kept letters, documents, comments from each as well as copies of all insertions in the *Review* over the years.

The blunt question is what to do with these files when you die? Would you like them sent to your widow? or children? I suppose you might like to have them now to read over, but these are generally the only source of information to write death notices. Some only have meagre contents,

but many have good impressive historical information with photos.

This is a tough question to answer, but if not asked, I won't have a decision. Please respond.—**Joseph C. Burley**, Secretary, RFD Box 416, Ep-
ping, NH 03042; **Lawrence B. Grew**, Assistant
Secretary, 21 Yowago Ave., Bradford, CT 06405

28

First, our thanks and appreciation to the many of you who sent us year-end greetings and good wishes. It is a time of year that gladdens the heart of a class secretary. **Mary and Max Parshall** sent us a photograph that shows their new Shimel piano. They already had a Steinway which then was out to be restrung. Pianos are important to the Parshall household—concerts are enjoyed from time to time and Mary has been teaching piano for many years. . . . **Art Robinson** says that his health is a bit precarious but has improved some over the past year. He enjoys some contact with Tech alums through his local MIT Club and retired men's group. . . . **Olive and Newt Foster** had to miss the 60th because of a family-related wedding. They have been "on the move" since June partly because of holiday visits to their various family groups. . . . A note from Verna and "Smitty" Smith brings chilly news of a December cold snap in sunny Florida (complete with frost on the ground). Of course they know it won't last. Smitty says that their activities are somewhat restricted by his eyesight problems but he did make it to the reunion last June.

Lucile and **Sam Weibel**, after spending the early part of last summer at their place in New Hampshire, took off on a 14-day tour of southern Europe. Theirs was an AARP group of 41 seniors flying from Boston to Frankfurt, Germany, then by bus as far south as Rome "roaming the paths of history and art." Sam says, "We enjoyed it certainly, but never had we climbed so many stone steps and walks. But we're still on our feet and ready for the next event(!) . . . maybe." . . . In their annual holiday letter, Gracia and **Tom Harvey** report enthusiastically on their trip to MIT last June. Later, in September, they took their sixth Mississippi riverboat cruise, this time on the *Delta Queen*. It was one of their best, taking them from Nashville, Tenn., to St. Louis, Mo., over the Cumberland, Ohio, and Mississippi Rivers. In particular, they enjoyed the lectures on Mark Twain and the history of steamboating.

Louise and **Ernie Knight** sent us a copy of their holiday letter. We were especially impressed by the following paragraph from their full and interesting report. "Life in the woods on Panther Pond has been good as our years of retirement increase, though the time will come when some part of the winter months will be spent with Paul in Portland. The woods, the pond, and the distant mountains are beautiful in good or bad weather. The birds and wildlife are always of interest, and nature either sings or howls depending on its mood. Yet civilization is crowding in on us as homes are built on our access road and Raymond is losing its status as a quiet country town."

As for honors: **George Chatfield** was elected chairman of Rotarians of Amateur Radio (ROAR), a 1000-member association. The event took place at the International Rotary Convention in Philadelphia in May 1988. . . . **George Palo** was reelected treasurer of his Condo Home Owners Association. This, he says, will keep him out of mischief. To both of these stalwarts, our congratulations! . . . The Palos had a note from **Claude Rice** who was George's close friend even back to student days. Claude reports that he now has a great-granddaughter. . . . We learn that **Walter Hildick's** daughter, Patricia, has been appointed medical director at Worcester State Hospital in Massachusetts. To her, our congratulations and wishes for every success.

Now it is our sad duty to report the following deaths: **Lycurgus Laskaris** died March 5, 1988.

Las graduated in Course 10B, chemical engineering practice. His professional life was devoted to research and development in the petroleum industry, all with Atlantic Richfield in Philadelphia. His reports to the class have always indicated that his was a happy life. Besides wife Ruth, our record shows that Las leaves a daughter and three grandchildren. . . . **Mieth Maeser** died July 12, 1988. "Slim" (to his friends) joined the class in our sophomore year and graduated in Course 4A, architectural engineering. He continued on to earn his S.M. degree, then taught for six years on the instructing staff in the Department of Mechanical Engineering at MIT. In 1934, he joined the technical staff of United Shoe Machinery Corp. in Boston where, as a research engineer, he enjoyed an outstanding career in all aspects of leather technology. His publication and patent achievement records are most impressive. Surviving wife Alice and daughter Doris now live in New Jersey. . . . **Herbert P. Dayton** died July 31, 1988. Herb graduated in chemical engineering and received his S.M. degree in 10A, chemical engineering practice. His professional career was with the technical service staff of Humble Oil and Refining Company in Baytown, Tex. Besides wife Charlotte, Herb leaves two sons.

Frank G. Webster died October 10, 1988. As a student, Frank studied without course specification. After a somewhat varied career of study, engineering and business that covered about two decades, Frank, in 1945, established his own firm of Black and Webster, Inc. to manufacture machine tools. The company is still a going and prosperous entity. Surviving Frank are his wife, Sally, three sons, four daughters, 15 grandchildren, and 11 great-grandchildren. . . . **Robert R. Peatfield** died December 29, 1988. Bob graduated in electrical engineering and made his professional career with Stone & Webster Engineering Corp. in Boston. He retired in 1975 after many interesting and productive years completing electric generating plants and transmission lines. In addition to wife Gertrude, Bob leaves three sons, six grandchildren and three great-grandchildren.

Just as these notes were being prepared we received notice that Araxie ("Roxie"), wife of our classmate, **Sarkis Sarkisian**, died on January 4, 1989. . . . To the families of all these classmates we extend our heartfelt sympathy.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890; **Ernest H. Knight**, Assistant Secretary, Raymond, ME 04071



*Mary and Max Parshall, '28 in
December 1988*

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60th Reunion

I received Christmas and holiday greetings from the following classmates whose news I will report. Sally and **Bill Bowie** write from Oldstedville, N.Y., where they "enjoy the beautiful winter scenery and wildlife. Sally is feeding a fox nightly and we have seen lots of deer running around. Plans for the 60th reunion sound good and we are looking forward to it. Haven't decided [on] housing accommodations, but campus location is attractive because of less need for transportation. While we are both still driving, the increase in traffic is becoming troublesome. . . . We are thinking a little about Florida in the spring and if we make it I will let you know". . . **Butler King Couper** of Tryon, N.C., sends his "best regards to all". . . Doris and **Bill Baumrucker** of Marblehead, Mass., say, "We will surely see you in 1989."

Frank and **Paul Donahue** of Nahant, Mass., plan to be "at our grand 60th reunion in June, 1989". . . Dorothy and **Joaquin Llanso** of Woodlands, Tex., write: "Though a bit plagued by health problems, we still continue leading an active life". . . Mary and **Frank Mead** of Marion, Mass., and North Point, Fla., write: "You may recall that Frank was on the disabled list last summer when he had a broken tibia. Well, this summer it was my turn. In late May, I developed a hernia on my left side and another on my right side in July. Neither one could be pushed back in place so surgery was needed on both. In August, hernia #1 reoccurred, so I went so back to the hospital for the third time. To add insult to injury, a severe case of shingles developed in May and they are still biting. I did, however, have a lovely 84th birthday on November 11. A neighbor had 20 friends in for cocktails, then we went to Port Charlotte for dinner. Afterwards, we went back to another friend's house for birthday cake, coffee, and more drinks. It was great. Frank is playing golf four days a week, but I quit playing it. I am down to 104 pounds from 143 pounds. The doctor says that I don't have cancer; it is due to the process of getting old. We are both fighting the worst colds that we have had on our lives. We still maintain a busy social life, and have big plans for the holidays. See you all in June for our 60th reunion."

Teddy Fahey, widow of **Jim Fahey**, says, "See you next summer in Hampton". . . **Richard Piez** of San Mateo, Calif., writes, "Greetings to all. See you at MIT for our 60th reunion in June". . . Barbara and **George Meyers** of Wyomissing, Pa., write: "Somehow, we have managed to fit in tennis about twice a week. George is just getting back after a shoulder injury. Barbara is involved with Alter Guild, E.C.W., Hospice Forum, soup kitchen, and Order of St. Luke and Companions. Aside from battling with the computer and the VCR, George is involved in Lay Eucharist Ministry, Crime Watch, Convenor for the Order of St. Luke, and writing a paper for the Torch Club: 'Search for the Future'. We are planning to attend our 60th reunion in June 1989 at the MIT campus."

Hellen and **Neal Wells** of Pinellas Park, Fla., are "looking forward to being at MIT in 1989 for the big celebration." They send "best wishes to all". . . **Chung Foy Yee** of China wrote while visiting friends in Worcester, Mass. "I wish you and the rest of our classmates good health and happiness for the coming year. Hope to see you at the reunion at MIT."

Robert K. Miller of Allentown, Pa., lost his wife on September 18, 1988. His new address is 543 Walnut St., Allentown, PA 18101.

I regret to announce the death of the following members of our class: **Thomas H. Speller**, of Buffalo, N.Y., on August 3, 1988; **Seymour A. Baum**, of Jupiter, Fla., on August 5, 1988; Mrs. **Mabel C. Merritt**, of Dedham, Mass., on October 10, 1988; and **Ira H. Abbott**, of Newport News, Va., on November 3, 1988.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

From Vancouver, B.C., **Joe Kania** reports that he has sold "Kania's Kastle," an unusual triangular house he designed, which has been called "the most photogenic house in Vancouver." Having acquired both a B.A. and M.A. from the University of British Columbia before coming to MIT, Joe is somewhat older than most of us, but at 87 he is in good health, talking daily walks, regular swims, and playing his violin. He is moving into a condo with a "lovely view of the city, the water, and the mountains." . . . **Bill Griffith** was a consulting engineer in Tucson in the fields of mechanical construction and air pollution control when he retired. He and his wife are in "very good health, active in church work, playing golf, boating, and scuba diving." For the past two years they have gone to the Philippines in January with an evangelical healing team of the Barnabas Ministries.

Last August 12 the *Wall Street Journal* reported that **William R. (Bill) Jackson** has retired as chairman and chief executive officer of Pitt-Des Moines, Inc. . . . **Allan Stone** writes from Elkart Lake, Wisc., that recent years have not been too kind to him. Both he and his wife have had difficult health problems. He does, however, send a cheerful "Hello and Best Wishes" to his classmates. . . . In his first communication since 1964, **George "Terry" Theriault** reports that he retired in 1973 as superintendent of Tools and Maintenance of the Frigidaire Division of General Motors. He and his wife Dorothea now live in Natick, Mass., where he is active in Masonic work and pursues his hobbies of photography, gardening, and woodworking.

Once again we regret to report the deaths of several more classmates, specifically **Howard Gardner** on May 4, **Albert Wagar** on August 4, and **Mendall Thomas** on August 29—all in 1988. As previously reported, Howie's career involved a number of switches between industry and education. After a start with Eastman-Kodak, he became director of the MIT Practice School Station in Bangor, Maine, from 1936 to 1949. He later became research director of Fiberboard Products in Lafayette, Calif.; chief of the engineering section at the Institute of Paper Chemistry in Appleton, Wisc.; and professor of pulp and paper technology at the College of Forestry, University of Washington, from which he retired in 1979. Shortly before these notes were written I had a telcon with Howie's wife "Teddy" (whom I first met on a double date with Howie at MIT) and learned that he had suffered from Alzheimer's for several years before his death while living at their retirement home, a condo community in Laguna Hills, Calif. He is also survived by two daughters, Ellen and Carol, and three grandchildren. . . . **Albert Wagar** was born in Whitehall, N.Y., lived in Albany for many years, and worked for Cluett, Peabody & Co. in Troy. For 20 years before his retirement he was the company's chief industrial engineer. He is survived by his wife Louise, two sons **Albert Jr.** of Germantown and **Charles** of Troy, five grandchildren, and two great-grandsons. . . . **Mendall Thomas** was born in Boston but lived in the Hartford, Conn., area most of his life. He was a hydraulic engineer with the Water Resources Geological Survey, Department of the Interior, for 43 years before retiring in 1973. During his employment he developed and published a "Flood Flow Formula for Connecticut." He is survived by his wife Dorothea, son Warren, daughter Nancy, and five grandchildren.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

Jack W. Lane, consulting engineer for Compagnie de Raffinage et de Distribution Total France, received the National Lubricating Grease Institute's (NLGI) Spokesman Award for his outstanding



*Mr. and Mrs. John F. Bennett, '30
at their wedding last April*

ing contributions in the field. The NLGI collects and disseminates information on the manufacture and use of lubricating grease. Lane was a member of the NLGI board of directors from 1952 to 1986. His career has included the Franklin Motor Car Co. (1930-31), mechanical engineering instructor at MIT (1931-34), Socony-Vacuum (1934-37), Socony Mobil Co., and Mobil Oil Corp. After retirement in 1974, he became a consultant to CRD Total France. He and his wife, Margaret, live in Crestwood, Tuckahoe, N. Y.

Edward J. Norris reports that he had a massive heart attack in October 1987, after which an angioplasty was performed. He says, "Our property in Windham, Maine, was sold, and we have rebuilt in Portland, to be nearer to medical facilities and to have less land to manage. During 15 years of retirement, I have kept busy doing real estate appraisals, a little surveying, and some engineering designs. I enjoy fishing around Casco Bay islands, gardening, and exploring the many country sideroads with Florence, my wife." . . .

Leonard A. Schuttig says he is a jazz pianist and puts on shows for "shut ins" and senior groups. He is also a professional yacht captain, and he enjoys swimming and traveling, often to the Orient. . . .

Clifton A. Smith writes, "After the loss of my wife, Dorothy, in 1983 and my second wife, Venna, in 1987, I moved from Santa Rosa, Calif., to McLean, Vir., where I have an apartment at Vinson Hall, a privately-operated residence foundation for retired officers of the navy, coast guard, and marine corps and their spouses." He also mentions sailboating in San Francisco Bay and, more recently, powerboating near Stuart, Fla.—**Edwin S. Worden**, Secretary, P. O. Box 1241, Mt. Dora, FL 32757; **John Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158

Stuart Denton Miller writes that his wife and he volunteer their services to a Pittsburgh hospital several days a week. They are active at the Mt. Lebanon United Methodist Church. Stuart has a wood working shop in the basement and is busy with several projects. They do a bit of travelling to Florida in the spring and to Maine in late summer. . . . **Russell S. Robinson** reminds us that his adventurous life began as a member of the Second Byrd Antarctic Expedition in 1933-1935. He was born in New Zealand and was with the Royal Australian Air Force during World War II. Russell, you are not boring to your classmates! We are interested in your adventures and thoughts. . . . **Kenneth Wolcott Smith** writes us an upbeat letter showing that life can be good at 79. While he and his wife do have some health problems, nonetheless, they are busy with golf, Kiwanis Club, friendships, and civic activities. His interests include wildlife, environmental problems, and beach erosion on the West Coast of Florida. They are proud of their family, especially the eight grandchildren—the oldest girl is getting married in their church soon.

Bob Minot and his wife Kay are feeling well and enjoying life. They spent two weeks in London visiting their daughter. Bob is still professionally active on a part-time basis. At present, he is working on two houses in Nantucket. . . . **Thomas Hannafin** is in good health. He has four children and six grandchildren. He hopes to make our 60th reunion. . . . **Richard Cochrane** is retired. His hobby is baseball statistics and he writes for the Society of American Baseball Research. He has a sophisticated way of evaluating players and teams. I must confess I can't read my telephone notes. Richard, write to us about your statistical studies—your classmates will find it interesting.

Roy Haeusler wrote me a good letter. Excerpts follow: "As for the Haeuslers, we are still going reasonably strong. Aileen has done a good deal of writing—mostly letters, to friends, government officials and newspapers. She still gardens, although the freezing of the ground will stop her for a while. I've been treasurer of the Independence Land Conservancy, a local organization dedicated to preserving open spaces and protecting wildlife and the quality of lake and stream water. Oh yes, I'm still doing a lot of work maintaining our 'castle' and repairing its equipment—pumps, furnaces, air conditioning, security alarms, and the many electrical appliances. Our two acres have lots of trees—I still have a lot of leaf raking to do. My progress in my writing on automotive safety is truly disappointing—and there's so much to say, there's so much more to do!"

It's my sad duty to report our loss of **Robert Semple**. He was active in our class and for MIT. He holds many honors from MIT. After working several years with Monsanto Chemical Co., he was named president of Wyandotte Chemical Corp. in 1949, and later he was chairman of the Base Wyandotte Corp. Always a musician he spent nearly 20 years as president of the Detroit Symphony Orchestra and helped promote it to world class stature. He developed a friendship with a fellow clarinetist, Benny Goodman. When asked by the *Detroit Free Press* to explain his civic activism he said, "it all flows from a sense of responsibility."—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

Nathaniel Goodman of Shawnee Mission, Mo., has held management positions with Sears, was vice-president of Jersey Shore Manufacturing Co., GM Production Consultants, management engineer at Menorah Medical Center in Kansas City, and is now with SCORE. He has four children and two grandchildren. . . . **Neil Hopkins**

of York, Pa., grew with York, Alias Borg Warner, DC research chief engineer Absorption Systems. He enjoys symphony chorus, church choir, and occasionally solo.

Ken Ryder of Weymouth, Mass., was a long-time class representative to the Alumni Council. He was in the Army Reserve and his now retired from a professional life in sanitary engineering.

Converse W. Sweetser of Huntington, N.Y., spent his worklife at Grumman, retiring as project officer, F-one eleven. He calls it a "long, happy uneventful career." His hobbies include choral singing, church activities, and how and garden maintenance.

Harry Summer of Evanston, Ill., retired from Bell and Howell—Columbia Video. His lifetime participation of Inter-Faith community activities found "results satisfactory in as much as they affected other lives." Nice thought. . . . **Bob Dobson** and his wife enjoyed their reunion. Soon after they traveled to Helsinki, Russia, Poland, and East Germany, and were impressed with improvements in Russia since their last visit in 1974.

Morris Cohen emeritus professor, was feted as the recipient of the National Materials Advancement Award in Washington on December 6. . . . **Charles F. "Red" Payne** of Port St. Lucie, Fla., retired 16 years ago as superintendent of the Paper Mill Division of Eastman. He spends winters in Mexico, New Zealand, and Southeast Asia. His wife Marcia landed a 6-pound rainbow brown trout in New Zealand.

Very sad news for the many who knew and loved him—**Clarence Royal "Westy" Westaway** died in early November at the Weston Manor. Westy's entire career was with Ingersoll Rand Corp., where he was senior engineer in hydraulics and nuclear-power generating, developing specialized pumping requirements for liquid fuels used in missiles and launch vehicles. He worked with NASA and other government agencies as his company's representative. Westy was our best-dressed, most eligible bachelor; enormously loyal to MIT and to his class. He was a resident member of the St. Botolph Club in Boston, the Brae Burn Club, and the Faculty Club, and was active in Boston's Trinity Episcopal Church. Gifts to the Alumni Fund in his name or as a memorial to all deceased classmates would be a fitting remembrance.

Allen Hinkle died September 25 in Signal Mountain, Tenn., shortly after attending our reunion. . . . **Samuel S. Saslaw** died September in Jacksonville, Fla. He retired in 1980 as professor of math at Annapolis. . . . **Kenneth A. Sawin** of Wellesley, Mass., died October 26. He is survived by his wife Evelyn.—**William B. Klee**, of Wellesley, Mass., died October 26. He is survived by his wife Evelyn.—**William B. Klee**, Secretary, P.O. Box 7725, Hilton Head Island, SC 29938

34 55th Reunion

Some new and fairly shiny Alumni Fund notes are at hand this month. Our travelers are still going strong. **Walton Hofmann** writes, "Have just returned from the Far East where spouse Edith and I visited daughter Sue in Sumatra; then some exciting time in delightful Singapore, surprising Malaysia, and astonishing Thailand. All on our own—no tours! Hope to be in Baton Rouge for Christmas with son and family, then back to Arizona for desert sunshine and golf. Best regards to classmates. . . . From **Irving Kusinitz** comes; "Our trip to Israel in early 1988 was one of the most impressive of our sojourns. Walking in the areas so familiar to us all from our bible studies cannot be adequately described; it is just felt! Since then we toured Yellowstone National Park (before the fires). Another great experience, this time to see what nature can do." On a more modest scale **George "Benny" Fowles** says, "On our usual summer flight to Boston we visited on Cape Cod with **Ray Jewett**. Talked about our 55th reunion but haven't received any information yet. On returning to Sarasota for the

winter ran into Peg and **John Hrones** and expect to see them and others at the MIT Club meeting on November 16.

Richard Bell took the trouble to write me directly about a most elegant-sounding trip he had recently made. He says, "Anne and I have just completed (in September) a round-the-world flight in a chartered Air France Concorde stopping at Tahiti, Sidney, Hong Kong, New Delhi, Agra (a side trip in a small aircraft) Luxor and Cairo, Egypt; Paris, New York and back to Scottsdale. At each stop we spent three or four days with side trips to Moorea at Tahiti, the sights and sounds of New Delhi, the tombs at Luxor and the Pyramids of Cairo with a special dinner in a large tent at the Pyramids. The trip was 21 days long and was magnificent."

Unfortunately I once more have a smattering of losses to report. **Gillete K. Martin** died April 12, 1988, in Pensacola, Fla.; the only other information I have is that he is survived by his wife Dorothy. Similarly I have word of the passing on April 17, 1988, of **Loren H. Hutchins Jr.** in Portsmouth, N.H.; leaving a widow Isabel. The last one comes closer: **John Strend** died in Ft. Lauderdale, Fla., on July 29, 1928; and is survived by his widow Selma. John and I had been close friends in our last two years at Tech—our senior year he was chairman of the Combined Musical Clubs and I had been the concert manager. He spent his working years in the steel industry in the Chicago area, moving to Florida after his retirement. I had a chance to spend an evening with him and Selma on a trip to that area about three years ago.

I know we all join in condolences to the surviving widows in their losses.

By now you should have received the material about our 55th reunion at Chatham Bars Inn on Cape Cod, June 4th, returning to Cambridge on the 9th for Alumni Day activities. We hope a goodly number will want to come; please send your reservations as soon as possible. If you didn't get forms and want them, contact Eliza Dame at the MIT Alumni Office, 77 Mass. Ave., Cambridge, MA 02139; or call (617)253-8350.

The class is inviting widows of classmates to attend the Cambridge activities as guests of the Class. They are also more than welcome at the Cape Cod portion, but regretfully, they would be expected to pay for that portion of the reunion. Would you please pass the word along to any one that you know. Again, contact Eliza Dame for the forms.

I have written several times of class members who have seen **Wing Lem Wu** in Beijing during visits to China and who have found out how much he would like to make a return visit to the United States but how impossible it is on his own resources. A group closest to him have formed an ad hoc committee to try and raise funds to bring him over here for the reunion. They are: **Hank Backenstoss**, 408 South Tulpehocken St., Reading, PA 19601, Chairman; **Doc Doyle**, **Walt McKay**, and **Ed Asch**. Wing has been a professor of aerodynamics at Beijing, and has survived Mao, the Red Brigade, etc. Those of us who have visited him in China know the fascinating stories he has to tell. The committee is trying to raise \$3,500, and is looking for 35 contributions of \$100, but any size contribution is welcome. If you would like to take part, contact Hank at the above address with your pledge. Anyone making out a check should make it to the Wing Lem Wu Travel Fund.—**Robert M. Franklin**, Secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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Dot (Mrs. Art) Haskins did a fine job filling in when Art couldn't write his usual Christmas letter. Dot explains, "Art was elected first reader of our C. S. Society. Although he enjoys the preparation work for the services, it is taking a great

deal of time." Art took first place in his class in the Casco Bay Interclub Regatta and won the Lanzer 22 State Championship. "In between, he blew the August series by running aground." Son Dan was awarded the Lanzer 22 Sportsmanship Trophy with his work as committee chairman of the regatta. . . . **Les Brooks** reports he is still doing a little consulting. His favorite client is in Monterey, Mexico, where they have a fine golf course and he can enjoy practicing his Spanish with the lab staff—"bonita muchachas!" A Vanderbilt co-worker stopped by in July en route to retirement in Texas. He and Les got in three rounds of golf to "no decision": 89-93, 93-89, and 93-93. "So Grandpa Brooks ain't washed up yet!"

In October, Marjorie and **Bill Parker** celebrated their 50th wedding anniversary with a reception hosted by their three children's families in Arkansas. A week later college friends and 1938 ushers with their spouses came from California and Colorado and royally entertained them for three days. They completed their celebrating by going back to New England and being with 1930 and 1950 friends and Bill's siblings. Their "annual Thanksgiving Day dinner at the Ziegler's was attended by 52 family, in-laws, and friends from ages 3 weeks to 80-plus years (also seven dogs and a rabbit)." Bill reports his new stainless steel knee hasn't improved his golf game yet but he has high hopes for the new season.

Clark Nichols writes from Searsport, Maine, that his IEEE activities included membership in the Power System Engineering Committee, 1952-60; chairman, System Controls Subcommittee, 1956-60; Power Generation Committee, 1961-70; and chairman, Working Group on Power Plant Response to Load Changes, 1968-70. He is presently a licensed professional engineer and fellow in the IEEE. Since retiring in 1976, he has been the volunteer treasurer and member of the board of trustees of the Penobscot Marine Museum in his home town. . . . **Clyde M. Leavitt** of Ocean Springs, Miss., emphasizes that his degree is in naval architecture and marine engineering, and he particularly objects to its being shown as ocean engineering.

In the meantime, your class secretary is thoroughly enjoying his new life in southern California.—**Allan Q. Mowatt**, Secretary, 715 No. Broadway, Apt. 257, Escondido, CA 92025

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Not wanting to favor the East versus the West (of the Pecos, that is), which I have done for several issues in recounting our long camping trip, I hid myself to Los Angeles at the end of October to meet with a number of classmates in the vicinity. And what a welcome! Classmates and friends demonstrated the warm hospitality for which southern California has a reputation.

Dick Murrow, Course XVI (with a S.M. in '37), in the Westwood area has difficulty moving about due to hip and knee replacements, but can drive. He has a pool, which allows him to exercise. Dick enthusiastically told of his experiences in aeronautical design and testing for Douglas, Hughes (Spruce Goose), Northrup and Rand (see 50th reunion biographies). At one time he designed timing devices for delayed action blasting of wells and took over the manufacturing when the plant owner went belly-up financially. Dick recalled undergraduate days at the Sigma Chi house on Beacon Street, which then bordered the Charles River. He and another Sig got a rowboat and at midnight rowed to the end of the basin, got the attention of the lock keeper to open the lock, then rowed in Boston Harbor, back through another lock operation, and home again unscathed. Dick mentioned two other '36 members with nearby California addresses. **Scott Rethorst** and **Jim Sounder**, but both their telephones were disconnected. If any readers have information, please call me or drop a card, along with items about yourself.

On a Sunday morning I met with five class-

mates for brunch at the Pasadena Hilton. Good food and good company: **Charles Price** (Course III), **Bob Osborn** (a graduate member of Course VI), ex-president **Tony Hittl** and wife Dottie, president **Alice Kimball**, and **Henry Lippitt**. Alice was at the far end of a cross-country tour from Connecticut, between Labor Day and December. **Bill Mullen** had to be away—and **Dick de Wolfe** planned to attend but was held up.

Charlie Price told of going to Germany in 1987 to trace his roots. His father, a U.S. Marine major in World War I and lieutenant general in World War II, had come to America as a young orphan with family friends around 1890. Somewhere in the process, his name was taken to be PRICE, which was the only spelling he ever knew. After searching through handwritten records in Hamburg City and a private geneology service, Charlie finally found his father's real name: Berthold Frederick Charles PREISS. Classmate Charlie had a wide experience in wire rope and cable engineering, and if you ride the sightseeing chair lift at Palm Springs, remember that he was in on the deal for U.S. Steel.

Bob Osborn came into our class from the University of Colorado as a graduate student in Course VI. During the war he was a Navy radar instructor in Boston and later taught at Annapolis. He then spent many years with North American Aerospace at Anaheim, which became Rockwell, and he was chief project engineer for the guidance and control system of Minute Man. Changing to data processing at Litton in 1970s, he still works "half-time"—a day at Litton, a day at home, then back to work to rest up.

Inveterate travelers **Tony Hittl** and Dottie motored from Laguna Beach to attend our brunch. Last spring they took the QE 2 from San Francisco through the canal to Southampton, then on to Austria for a visit with daughter Barbara and her husband, to Madrid, and eventually home. . . . I'll save reports on Alice and Henry for next issue, when I will have their year-end notes and greetings at hand.

Wheeler Coberly, a graduate member of the class who is one of **Bill Rousseau's** group of Course X-A correspondents, could not attend the brunch, but told me an anecdote over the telephone. He was one of group of three who stopped between Building 8 and Walker Memorial to talk with Norbert Weiner, who after the discussion asked what direction he was moving before hand. Does it happen often? Seems I've heard of such from others.

Tung Lin (Course XVI) of Pacific Palisades and professor emeritus of U.C.L.A., still has contracts with the Air Force and the Office of Naval Research. One of his specialties is metal fatigue, the subject of his book *Theory of Inelastic Structures*. He agreed with me that, with the near tragedy of the Aloha Airlines plane peeling apart last year, his work is not going to decline. Not long after graduation, Tung was chief engineer and production manager of China's second aircraft plant, and created the first airplane designed, built, and successfully flown in China—from Chunking to Chengtu in 1944.

Bill Kennedy, a graduate member of the class (Course XVI), also could not attend, but later wrote interesting additions to his biography: In commercial aircraft sales campaigns for Lockheed he met and dealt with Jimmy Doolittle, Howard Hughes, Eddie Rickenbacker—all the greats. And before the jet age, at a presentation to Pam Am on prop jobs, Charles Lindbergh told him, "You must make your airplanes go faster, fly higher, and carry more passengers." Bill considers Lindbergh one of the best in aviation history, and truly prescient. Later Bill tried to sell Lockheed jets to Juan Trippe, then president of Pan Am, showing him the simple rotating parts versus the complex array of valves and crankshafts of piston engines. Within a few days Trippe bought Pam Am's first jets—British Comets!

Now, to start on the numerous notes you included in response to the Institute's questionnaire last year. . . . **John Allen** (Course IV), retired

from the firm of Ballou & Justice, has achieved considerable stature as an artist. He does landscapes in acrylic, shows at local exhibitions, and has won awards. Some of his paintings are in private and corporate collections. . . . **Gerard Chapman** (Course X-B), retired research chemist in cement and paper, is a freelance contributor to the *Berkshire Eagle* (Pittsfield, Mass.) writing bi-weekly on local history. He also writes occasionally for *Antiques* magazine, *19th Century*, and the Hudson Bay Company's *Beaver*, and serves as library trustee and is a director of environmental and eleemosynary organizations. Travel with wife Edith fills in his spare (?) time. . . . **Martin Gilman**, in addition to the many retirement activities listed in the biographies, is Lexington Township Fence Viewer. All our readers know of New England town meetings, of which Gil has been an elected member since 1951, but how many know and appreciate the office of fence viewer? I would relish the job, knowing it from the sidelines while a resident of Vermont.

C. Mallory Graves (Course XV), retired professor of management at Central Virginia College, puts his time and energy into working for peace and justice. Mal praises the efforts of Institute faculty members Jerry Wiesner, Noam Chomsky, and Henry Kendall in such endeavors—"It is good to have those whose judgment you trust speak out." . . . **Bill Hastings**, also XV and retired after reaching the upper echelons of investment banking, takes a dim view of the decisions made in that field, and current news bears him out. Bill is multilingual, and has been to all the Iron Curtain countries except Bulgaria and Rumania. . . . **G. Dudley Mylchreest**, who entered Course I in his junior year from Wesleyan, is stricken with Alzheimer's and is in a nursing home in Simsbury, Conn. Wife Laura wrote that "from what he has said I would guess that he would rate his experience at MIT as a happy and rewarding one." God bless you and keep you, Dudley.

Pete Weinert, arriving in Florida on October 19, learned that his good friend **Andre Brisse** of Ormond Beach had died suddenly the same day. An aortal valve was operated on two months earlier, but infection set in. Andre's many accomplishments as manager and director of research and development for U.S. Steel are given in the 50th biographies, along with brief mention of community affairs involvement. His widow Gloria (161 Deerlake Circle, Ormond Beach, FL 32074) told me that tributes poured in from church and hospital, of which he wrote a history of the auxiliary he served. Cheers and a toast to Andre's life and work! . . . And for **Milton Tarnhopal** (Course III graduate student), who died August 13 in Montrose, Calif. He did research for Pittsburgh Plate Glass for many years and held numerous patents, including one for defrosting glass.

In the midst of year-end holidays we think of you all—the pleasant visits and telephone conversations, and letters with both news and requests for information. I did not try to "card" you, but please know that your warm responses to our inquiries are greatly appreciated. Thank you all from Pat and myself. We have used more than our share of space in several issues, so I'll save mention of season's greetings received until the next issue.—**Frank L. Phillips**, Secretary, 901 Los Lovatos, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, Assistant Secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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Jonathan B. Cobb, 1700 W. Bender Rd., #260, Milwaukee, WI 53209. He retired June 1975 as a chemist, technical service, with Pittsburgh Plate Glass Industries. Wife Eleanor's main interest is travel. His hobbies are lawn bowling, photography, bridge, and sheephead (a Wisconsin local game). He reports that both of them are "quite healthy." Recent travels have been to Bermuda and the Bahamas. . . . **George DeArment**, 200 N.

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617-253-4733

Main St., Meadville, Pa., retired as president, Chanellock, Inc., on January 1, 1981. Wife Janet's main interest is the Red Cross Bloodmobile. George recently received the Citizen of the Year Award from the local 219 Elks. He also was honored as Distinguished Citizen, French Creek Council, Boy Scouts of America. His hobbies are golf and stamp collecting, and he is a director of the Meadville Area Recreation Authority. In February 1988 he went to Australia and New Zealand and last January went to Peru, Argentina and Brazil. . . . **Joseph M. Engel**, 12800 Pinebrook Ln., Bayonet Point, FL 34667, didn't send any personal news but noted that he feels the derogatory comment by MIT economics professor Robert Solow on national TV about George Bush were detrimental to the image of MIT.

On December 8, 1988, Rachel and **Albert Schulman**; Dorothy and **George Rosen** of Hartford, Conn.; Lucy and **Irwin Sagalyn** of Ashfield, Mass.; Genevieve and **Leonard Seder** of Lexington, Mass.; and Pearl and **Lester Klashman** of Medford, Mass.; met at the Whistling Swan restaurant in Sturbridge, Mass., and held a mini-reunion dinner. The Schulmans were planning a winter trip to Tortilla in the Caribbean. The Sagalyns were planning a trip to Bermuda where Lucy plans to participate in a bridge tournament and Irwin plans to play golf. The Seders are planning to spend six weeks in February and March in Del Ray Beach, Fla., and the Klashmans are planning a trip to La Jolla, Calif., January to March. Everyone seemed to be in satisfactory health and a good time was had by all.

Charles M. Antoni, Bldg. 3, Apt. 500, 211 Lafayette Rd., Syracuse, NY 13205, writes, "Retired as professor of civil engineering, Syracuse University, in 1983. My volunteer work is mainly at CIM Hospital once a week. Spent last May in Europe. We're living a relatively quiet life. No other news." . . . **John H. Fellouris**, 1290 Rockdale Ave., New Bedford, MA 02740, writes, "I have been quite busy completing 26 deluxe con-

dos so no Florida this year. Daughter Mara as of February 1, 1989, has accepted an assignment to Nairobi, Kenya. We plan to visit her this summer." . . . **Ferdinand F. Ferrary**, 20 Swanage Rd., Richmond, VA 23235, writes, "Retired nine years. I am doing some consulting for AMF Bakery. I am enjoying my computer . . . It's a great hobby."

Robert H. Thorson, 66 Swan St., Winchester, MA 01890, writes, "We are both well. Rose had cataract surgery in April which worked out fine. Attended the 50th wedding anniversary of Bunney and **Ralph Webster** this summer. Saw June and **Walt Wojtczak** and **Peggy** and **John Fellouris** at the reception and agreed that as Mark Twain said 'getting old is not for sissies.' . . . **Stan Zemansky**, 6160 Beacon Court, Paradise, CA 95969, retired as city purchasing agent, Baltimore, Md., June 1982. His last monograph in 1988 was "Ethics and Quality Public Purchasing." He continues writing articles and books and conducting seminars around the country. He writes, "enjoying freedom of action in the catbird seat of retirement. Son Les is having an unusually good teaching year. Son Gil, a Ph.D., is in charge of water quality work in an environmental consulting firm. Daughter Sondra is an associate in a law firm, specializing in family and civil law."—**Lester M. Klashman**, Secretary, 289 Elm St., Apt. 71, Medford, MA 02155

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Roberta and **Horace Homer**, our class president, spent two weeks on a cruise including stops in Egypt, Israel, Turkey, and among the Greek islands. Being the last cruise of the season for this Greek line, they had the advantage of half the passenger complement and an exclusive 15 in their party. . . . **John D. Cunningham, Jr.** retired from business in 1983. Since then, he has been working in the law offices of two of his sons who are in their own law firm. Thus he has the best of both worlds: keeping his hand in his profession and having time for his interests in sailing and motor boating in season.

In the course of attending the opening of a new facility at the Manomet Bird Observatory, an organization devoted to long-term research and education in environmental biology, Phyl and I had the opportunity of a delightful long luncheon with **Sandy** and **Lou Bruneau** and **Nancy** and **Dave Wadleigh** at Chatham Bars Inn.

Bob Johnson called just before Christmas. Following our 50th reunion, he had a bad fall requiring knee surgery and confinement to a walker and crutches for six weeks. As though that were not enough, in November his heart placed him in the hospital again. All's well now! By the time you read this, he and Pat will be in Florida until about May with the possible exception of a trip or two back for directors meetings.

From **Fred Kolb's** Christmas message, it is clear his was an extraordinary 1988. Following our June reunion, there was another formal gathering of those with whom he had shared his long professional career—those Kodak alumni who qualify for The Society for the Preservation of Manufacturing Experiments Memories.

Another highlight was an extended pilgrimage primarily in France in the Valley of the Massif Chartreuse. Not only was this trip an occasion to visit an area which had developed a special attraction for him and Polly, it also permitted him to visit many long-time friends and associates of those years when he virtually commuted to France on Kodak business.

Although officially retired since 1986, Fred still meets near-weekly with former associates and remains active in his specialties of magnetic film recording and reproduction, patent literature, and international standardization. In this connection last October at a Conference in New York, he was presented the coveted Samuel Warner Award for contributions to motion-picture audio. Congratulations!

Although this is being written New Year's Day,

by the time you read these notes we shall be compiling the list for announcing our June mini-reunion at Endicott House. Let **Horace Homer**, **Ed Hadley** or **Don Severance** know of your interest to assure getting an announcement—unless, of course, you've been attending regularly in the past.—**Don Severance**, Secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, Assistant Secretary, 50 Spofford Rd., Boxford, MA 01921

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50th Reunion

The formal committees for '39ers 50th reunion are working like 48 beavers. Unexpected informal volunteer groups are adding enthusiastic support.

The '39 class roster includes 388 names. Before Christmas about 100 had indicated their decision to attend the reunion and bring about 80 most important ladies. Best guess to date is that attendance will exceed 200.

Bill Wingard and **George Beesley** reminded me to report that the reunion starts Sunday, June 4, after lunch, at the Chatham Bars Inn in Chatham, Mass. Transfer from Chatham to Cambridge will be after lunch Wednesday, June 7. Chartered buses will be available. Events on campus and at Pops will be held June 7, 8, and 9. Reunion ends officially in Cambridge after lunch Saturday, June 10. Each classmate will receive direct mailings from major reunion committees and via **Manning Morrill's** bulletins.

Morrie Nicholson writes: "I attended the centennial celebration of the Metallurgy Department at the Institute last June. About 200 came, including classmates **Louis Castleman** and **Bill Cutten**. Louis has been professor in materials science at The Polytechnic Institute in Brooklyn for many years. Bill is listed by the alumni office as a project engineer of the Lees Division of Burlington Industries in Bridgeport, Pa. . . . Following the celebration I toured France for three weeks via auto and barge. Now back in Minnesota, I have an invitation from **Aaron White** to lead some songs at our 50th. I wonder if you and **Johnny Alexander**, as old barbershoppers, would join me in leading some of the old favorites?" I phoned Johnny, who promptly agreed to help. Classmates who like the idea of a songfest are invited to send their requests and suggestions directly to **Morrie Nicholson**, 1776 North Pascal Ave., St. Paul, MN 55113; or to **Aaron White**, 177 Varick Rd., Waban, MA 01778.

Aaron White writes: "We will have two cracker-jack combos—a duo to play for the clambake and a quartet to play for the dance the next night. All musicians are old-pro recording artists who render in the jazz style of **Woody Herman** and the world-famous **New Black Eagle Jazz Band**."

Mike Herasimchuk and **Jean** were recognized by the Institute and honored in the January 1989 issue of *Technology Review* with a full-page picture and a "Donors' Profile" summary of career, gift of capital, and quote. In addition to his significant personal contributions to the Institute and '39ers' reunion committees, Mike started publication of *Course III/XIX Affinity Group Sporadic Newsletter*. So far, distribution includes 29 individuals who have common interests in career and associations, with news about both. Some of Mike's newsbits are: ". . . We had dinner recently in New York City at **Christ Cella's** (now owned by **Dick Cella**). Dick is committed to an appointment in Europe, which may prevent his attending our 50th reunion. . . . **Dick Kaulback**, now retired from Johnson Bronze, lives in New Wilmington, Pa., and is into word processors, amateur radio, and American folk art/antiques. . . . Others now interested in word processors and personal computers included **Evan Pancake**, **Aaron White**, and **Morrie Nicholson**. . . . **Morrie** is contributing editor to the newsletter."

George Cremer attended the first rollout of the new B-1 Bomber at Edwards Airforce Base in California. . . . **Barry Graham** and **Jean** expect to travel from Muskoka, Ontario, to attend our 50th. . . . **Charlie Wang** and **Julie** write from China

that they also hope to attend.

Elaine Kuhrt wrote to **Fred Grant**: "Recently Wes sent you his biographical sketch. The newspaper reported Wes died in an auto accident October 19. At first they thought he had a heart attack, but now it appears he had low sugar (Wes was a diabetic). He was really looking forward to attending the 50th reunion. We so enjoyed the 45th. There were 750-800 at the memorial service."

Seymour Sheinkopf relayed a clipping from the December 11 *Washington Post*: **Vahay S. Kupelian**, 76, an aeronautical engineer who had worked for the Defense Department for 38 years before retiring in April as deputy undersecretary of defense for strategic and nuclear forces, died December 9 at George Washington University Hospital. He served as director of engineers at the naval ordnance experimental unit. From 1968 to 1974 he was assistant director of the Advanced Ballistic Missiles Defense Agency. He became deputy undersecretary of defense in 1985. He received the Defense Department's Meritorious Civilian Service Award in 1976 and 1988 and the Army Department's Decoration for Exceptional Civilian Service in 1975.

Maureen Rugo writes: "I am still employed as director of the Harwich Council on Aging. Our children are all grown and married. Our youngest son, John, is now 30. He was 12 when Al died. His son, Albert, is now 5. I live in West Harwich, Mass., all year 'round in our summer home, which Al and I purchased in 1962. Community activities keep me busy."

Dodie Cassleman put it so nicely: "I am flying December 9 to Boston, where all the Connors and Casslemans will celebrate Margie and David's 25th wedding anniversary. Now, how does that make you feel? Not old, just grateful. Looking forward to June. Two reunions!"

This may be the last edition of '39er class notes to reach you before our reunion. If you haven't completed arrangements to attend or either pledged or contributed toward our \$3.9 million class gift, you have only a few days left to join in, share your inputs with classmates, and take away new once-in-a-lifetime memories.—**Hal Seykota**, Secretary, 1701 Weatherswood Dr. NW, Gig Harbor, WA 98335

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Donald M. Cole Jr., of La Habra Heights, Calif., writes that he retired in 1987. He is enjoying his hobbies of genealogy, philately, and PC, and he is looking forward to the 50th reunion. . . . From Bethesda, Md., **Alvin Guttag** notes that his first grandchild, **Christopher Wilson Guttag**, was born July 18, 1988. In the Maryland Senior Olympics last fall (in the 70-74 age group), he was second in the 1,500-meter race walk, second in the 10-kilometer run, first in the 5-kilometer run and third in the 1,500-meter run! That's great, Al! . . . **George T. Kaneb** is semi-retired. He works part-time with his sons in fuel oil distribution, warehousing, and industrial leasing. He goes on hunting and fishing trips, and spends the first three months of the year in Florida. George lives in Cornwall, Canada, but his mailing address is Box 176, Massena, NY 13662.

The Optical Society of America reports that **Stewart Miller**, of Locust, N.J., was honored for his work in fiber optics technology with the 1989 John Tyndall Award. This award recognizes Miller for "foresight, dedication, technical contributions, and pioneering leadership in building the broad foundations for today's fiber-optic telecommunications systems." Miller joined the technical staff of AT&T Bell Laboratories in 1941. His contributions in more than 40 years at Bell—including some 80 patents—were in the fields of optical fibers, lasers, millimeter-wave circular-electric waveguide research, microwave ferrite circuitry, microwave directional couplers, mode-selective transducers, coaxial-cable repeater systems, and microwave radar.

Miller also received the Institute of Electrical and Electronic Engineers' (IEEE) Morris N. Liebman Award in 1972, its W.R.B. Baker Prize in 1975, and a Stuart Ballantine Medal from the Franklin Institute in 1977.

A note from **John A. Vanderpoel** of Concord, Mass., states that he is still making athletic wheelchairs. He had a dozen or more in the Boston Marathon and six in the "Paralympics" in Seoul, Korea.

We have news of the death of **Alfred E. Castle** of Kentfield, Calif. Contributions may be sent to the Alumni Fund in his memory. The class sends its sympathy to his family.

I am always glad to hear from any class members with news of your activities.—**Richard E. Gladstone**, Secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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Former class president **John Murdock** sent a note describing an intriguing invention of an unusual swimming pool. In this new design, the water is pumped past the swimmer, allowing the athlete to "swim in place" in a much smaller space. . . .

Bob Blake narrowly lost his race for Congress. He was leading the primary by 300 votes, but lost by 140 votes after the absentee ballots were counted. Better luck next time Bob.

Robert J. Demartini tells us that he worked for 30 years for the Huyck Corp., where his final job was executive vice president, international. Now he teaches at North Carolina State University, invests in real estate, and has founded his own product development company. Currently he is promoting Gutterhelmet, a new concept product he patented to eliminate the perennial chore of cleaning roof gutters. Bob lives in Raleigh, N.C.

An issue of the Scripps Memorial Hospitals Bulletin describes a \$773,000 planned gift from Virginia and **John Fonseca** which will support ophthalmological research at Mericos Eye Institute. The Fonesca's accomplished this by transferring ownership of a 12-unit apartment complex which they purchased in 1962 for \$200,000, now appraised at \$800,000. Under a trust agreement with the SMH Foundation, the unitrust will pay the Fonescas for as long as they live a regular quarterly income. At the survivor's death, the principal goes to SMH for the Mericos Eye Institute. A tax deduction of \$283,710 will offset some of their 1988 income taxes or may be carried forward for up to five additional years. The Fonescas feel good about helping people keep and regain their vision. (Unitrusts can also be set up at MIT—Ed.)—**Joseph E. Dietzgen**, Secretary, Box 790, Cotuit, MA 02635

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I'm writing these notes on January 2, so Happy New Year to all.

Had dinner with **Audree** and **Jack Altekruze** and the MIT Club of Tampa Bay's meeting just after Christmas. Jack has retired from the Goodyear Atomic Corp. in Oak Ridge, still has a home in Silver Lake, Ohio, but plans to locate somewhere in the Largo area near here. Also at the dinner were **Joan** and **Dick Knight**. All will remember Dick as our very pleasant and efficient Alumni Association secretary. The Knights have a condo on Clearwater Beach for the winter and summer in Calgary, Canada.

Bob Rines received the international Beyond War award for his work with the Academy of Applied Science. No small honor, this award was given, also in 1988, to President Reagan and Mikhail Gorbachev for their signing of the INF nuclear arms treaty! . . . **Charlie Estes** is teaching a 32-year-old how to read and write in the Literacy Volunteers of America program. Charlie is also studying piano, using a KAWAI Digital piano. So we'll have some entertainment for our upcoming 50th reunion. . . . **Carl Zeitz** is still out there sell-

ing packaging and playing golf. He says that the packaging biz is doing fine but his golf is getting worse. Son **Barney** is on his way to becoming a nationally recognized stained-glass artist, with windows in major religious institutions, homes, and hospices.

Two new retirements: **Alan McNee** on a year's furlough from his position as professor of electrical and computer engineering at the University of Michigan, and **Cal Morser** as vice-president for programs at Itek's Optical Systems Division. In common with all our retirees, Cal is busier than ever, with management consulting and as chairman of the Vessel Committee for the rebuilding and restoration of the *Adventure*, a famous old Gloucester fishing schooner.

A hearty thank you to **George Illich** for a \$1,000 contribution to MIT. The Illichs still live in Lake Forest, Ill., and summer in Park Falls, Wis.

One obit this month: **George Granitsas** died at Delray Beach, Fla. George graduated from metallurgy, the old Course III, which is now materials science. Our condolences to his wife and family.—**Ken Rosett**, Secretary, 2222 Americus Blvd., N. Clearwater, FL 34623 (till April); 191 Albemarle Rd., White Plains, NY 10605

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A telephone call from **Jim McDonough** and a clipping from **Hans Walz** bring the sad news that one of our most enthusiastic and active classmates, **John E. Ward**, died last December 11 in Lexington, Mass. John was associated with MIT's Electrical Engineering Department for over 40 years, retiring in 1987. He was deputy director of the Electronic Systems Laboratory and a founder of the Laboratory for Computer Sciences. He was an expert in the technical aspects of cable TV systems. John was also a fellow of IEEE, a scoutmaster, a Lexington Minuteman, and a banjo player of 45 years' experience. We extend our sympathies to his wife, Jackie, and the other members of his family.

Hans also includes a little news about himself. He and Vicky are looking forward to a new grandchild, skiing in New Hampshire, and tanning in Florida.

Marion and Gilbert Monet announce their final retirement and a move from Wilmington, Del., to a community near Lancaster, Pa. They are enjoying their new "life in the slow lane" but manage to stay busy. Marion takes cello lessons and plays in the local orchestra. Gil has started piano lessons and is back into sculpture and stained glass art.

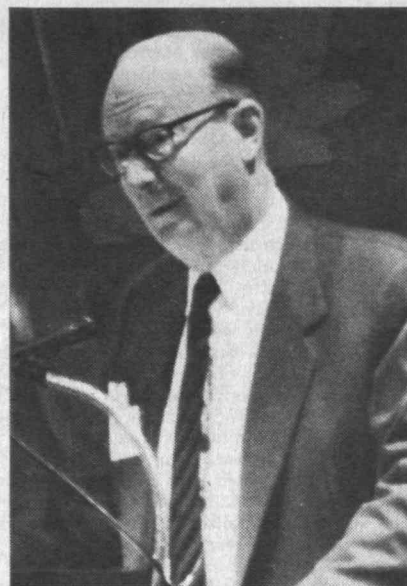
The October 1988 *Colorado Engineer* carried an article about **Paul Coulson**, who is president of the Metro (Denver) Chapter of the Colorado Professional Engineers' Society. Since graduating from MIT, Paul has been continuously involved with the aerospace industry. In 1971, he helped organize a firm to supply contract engineers for a variety of clients throughout the U.S. Although retired from this business for three years, Paul remains active in professional society affairs.

On one of those little cards you return to the Alumni Association, **William I. McKay** writes, "I'd like to see some news of class of '43, especially on meteorology in defense." I'd like to see some, too, Bill. How about sending whatever you have on yourself?—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Retirement continues to catch up with our classmates. **Peter Matthews** plans to retire this June. He is considering attending the 45th in Bermuda. Four grandchildren provide lots of fun. His daughter, **Andrea**, a lyric soprano performs with symphony orchestras all around the country. Peter suggests we keep an eye out for her. . . . **Seymour Bessen** expects to retire this year. With wife **Roz**, he hopes to spend more time on his

45th Reunion



Carl M. Mueller, '41, at the annual meeting of MIT Corporation Development Committee (CDC) last November, where he received the 1988 Marshall B. Dalton Award. The award, given annually in recognition of outstanding service on the CDC, is named after its first president, a member of the class of 1915. Also mentioned in the award citation was Mueller's service to MIT as recognized by the Bronze Beaver Award, the MIT Corporate Leadership Award, and his leadership as chairman of the Corporation Campaign Committee.

boat, **Roz II**, cruising and fishing the coastal waters from Santa Barbara to San Diego and on down to Mexico. First trip was early January this year.

Bill Sadler and wife **Rowena** recently returned from a trip to Paris and the Loire Valley in France. His only grandson, **Brent**, is a candidate in the freshman class this fall at MIT. . . . **Jim Weaver** is seeking a publisher for his pamphlet on comparative review of 38 texts on engineering economics/investment project appraisal.

John Gardner thought retirement six years ago would involve leisure but finds it hasn't happened. His list of things to do and family and friends visitations seems as long as ever. Flexibility in choosing work to do and times to do it is most appreciated. He is involved in nuclear power plant safety issues with IEEE and research organization. In non-professional activities, he is exploring ways to use proceeds from social security "entitlements" to advance the cause of individual freedom and responsibility—a plan for us to take care of ourselves and neighbors rather than depending on Uncle Sam to do it for us. He asks for any good ideas on doing this.

It won't be long now until our 45th reunion at Cambridge and Bermuda. We're getting a good response. As of last January, over 70 classmates planned to attend. If you haven't signed up, there's still time. Call or write us for details right away.—Co-secretaries: **Lou Demarkles**, 53 Maugus Hill Rd., Wellesley, MA 02181; **Andy Corry**, 16 Brimstone Lane, Sudbury, MA 01776

Nothing to report except a kind of poignant story about a notable classmate. Maybe everyone but me has read the October newspaper article announcing the death of **Generoso Pope**, "millionaire owner of *National Inquirer*." "Gene" was only 19 when he graduated. Six years later he borrowed \$75,000 and bought the then *New York Enquirer*. He soon boosted its circulation to 1 million. In the late 60s he went to super market distribution and ultimately became second only to *TV Guide* in circulation. He loved his work and relished the notoriety of his publication. He said in a recent interview, "If you took this away from me, I'd probably die." He beat them to it.

On a lighter note, we got a short item about Professor **Raymond Benenson**, who's been teaching physics at NYU-Albany the past 20 years or so. Turns out Raymond joined us in mid stride after transferring from NYU. Nine years later, he received his Ph.D. in nuclear physics at the University of Wisconsin, doing time at Brookhaven before and after. Then back to academe for the next 10 years at CCNY before moving to Albany where he specialized in developing laboratory experiments and research (particle-solid interactions). Through his endeavors, he picked up an Excellence in Teaching Award in 1988. Raymond and wife June, since 1956, produced three daughters—all grown. And now, living in a Schenectady suburb, they "rattle around" in a house too large for just the two of them.

After a recap of past columns, trying to get a grip on this job, I find quite a number of old classmates I have inexplicably overlooked. I'll start with **David Black**, another Double 'E' out of the June class (and its president!). No yearbook data, but he's ended up doing very well in research and its management, including an honorary Ad Eudem degree from Brown University for establishing an office of Coordinator of Research and founding Stonehenge Management, Inc., a consulting firm, in Pelham, N.Y., where he and wife Mary Elizabeth, since 1964, are living. Involved in numerous philanthropic endeavors, including being an MIT Sustaining Fellow, he somehow finds time for golf, woodworking, pool, and serious (I mean serious) boating. He hopes to sail to Scotland as a navigator with a Narragansett Bay Power Squadron group (if he hasn't already).

And what about good ol' **Ray Brown**? Did I see him at the 40th? Yes, I did. No subsequent data on him other than at last word he's still president of Eastern Tank Fabricators in Manhattan, N.Y., still married to Betty (since "day one"), and has four married daughters and a son, all living (fairly close to their home) in Scarsdale.

And there's **Sterling Bushnell**, I remember from swim team, came to us as an Exeter prep. Sterling worked for Howmet Corp. designing/building investment castings for jet engines until he retired in 1985. He always liked his job and "managed to see a bit of the world" along the way. Good show, Sterling. He has lived in La Porte, Ind., with wife Greta, since the mid 50s, and has two sons and two daughters.

Finally, how could I miss such a handsome guy with a name like **Bill Casey**? He jumped out of school into Amsted Industries (nee American Steel Foundries) and stayed there until he got it right, i.e. became president, after 30 years. He's still at it with no hint of retirement. Bill married twice, with two sons and one daughter and two grandchildren from his first marriage. Bill lives with his wife, Laura, in his hometown of Highland Park, Ill. Hey Bill, what is this "Fundidora de Aceros Teyeyac" organization you're a director of?—**Jim Ray**, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

We had a long letter from **John S. W. Kellett** this month. John retired from Exxon in 1986 and says

he is busier now than before he retired! He's president of the Houston Area Memorial Society, a member of the First Unitarian Church Endowment Committee, and active in the Texas Human Rights Foundation and the ACLU. His next objective is to get off all boards and committees by 1990. John has lived in Houston for 14 years and may spend his retirement there. He writes that the climate is rather good for animals (humans?) from October to May. In summer, it's better if you're a plant!

Earl Iselin has retired from full-time teaching at the University of Dayton. He is still working for the University as a part-time coordinator of continuing education and special programs in engineering, organizing workshops and seminars on current engineering topics. He and Alice now have more time for travel, restoring a log cabin, and sailing. "The work schedule is flexible and the last child has flown the nest."

Kenneth B. Amer recently retired from McDonnell Douglas Helicopter Co. after 30 years there. He worked on, among other projects, the Apache, which is now being introduced into the army. Ken was selected by the American Helicopter Society to present the Nikolsky Honorary Lecture at their 1988 Annual National Forum. He's also now doing some consulting work and traveling.

Edwin Cavanagh sold 75 percent of his company to ESOP in 1987. He retired but is still chairman; his wife, Skip, is secretary-treasurer. (Unfortunately, he didn't tell us the name of the company.) (Precision Babbitt Co., Inc., Paramount, Calif., is listed in the *Alumni Register*—ed.) Ed had surgery for cancer of the esophagus in 1988. We're happy to report both operations were successful.

Finally, a very brief note from **John Bryant Williams**: he's living in Rock Hill, N.C.—**Robert E. McBride**, Secretary, 1070 Pilgrim Pkwy., Elm Grove, WI 53122

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William Papian wrote to say he had a great time at our 40th reunion: "The lecturers were superb." Bill is 72 and his first interest in electronics dates back 62 years to a homemade telegraphy set. During the Depression he went to trade school, repaired radios, went to RCA Institutes and became a transmitter technician and station engineer for RCA out in Rocky Point, Long Island. During World War II he spent three years in N. Africa, Sicily and Italy. One of his big accomplishments was in-the-field design and development of a very successful radio direction finder, three of which helped track enemy movements through much of the campaign. His second big accomplishment: development of the magnetic core memory into the first really useful random-access-memory for high speed digital computers. He then worked with Wes Clark and Ken Olsen and the development of TX-O, TX-2, etc. Bill went on to Washington University in St. Louis. He has retired and is living in Shady Side, Md.

Charlotte (Potter) Fraser represented the MIT Club of Rochester at a joint meeting of the MIT Corporation and the Association of Alumni and Alumnae. The club was awarded a Presidential Citation for the success of their club which has six or seven high quality meetings each year, with good attendance at each one.

Don Atwood was awarded a Bronze Beaver at the same joint meeting. Don was recognized for his invaluable contributions to the Alumni/ae Association and Institute affairs. He filled leadership roles in the Second Century Fund, the Leadership Campaign, and as an alumni member of the MIT Corporation. He was recognized for his superb efforts and talents.

Marshall Baker and **Edward Stevens** were awarded the Morgan Award for their contributions as Educational Counselors. Marshall served as an educational counselor since 1954 and has been regional chairperson of the Wilmington

council since 1970. Edward served since 1960 and has been regional chairperson since 1982.

Edgar Rose is vice-president of engineering and research at Outboard Marine Corp. Edgar was elected to serve as president of The American Power Boat Association (APBA). As a member of APBA for the past 36 years, Edgar served on almost every committee of the association, in many cases as chairman. The association is the governing body for power boat racing and they work to improve boat design and construction, formulate rules, govern trials of speed and endurance, improve safety and to promote racing. Edgar has been recognized by APBA for his contributions. In 1952 he received the Mulford Trophy and in 1976 he was inducted into their "Honor Squadron." . . . **Sheldon Green** wrote from Belize in Central America where he is a Peace Corps Volunteer. He is counseling small businesses and teaching high school chemistry and math. He is enjoying the experience.

Juan Grau changed positions from CEO of Bacardi Compania in Mexico to president and CEO of Bacardi Import, Inc. in Miami. . . . **Jim Guida** and his wife enjoyed an Elderhostel trip to Sorrento and Sicily. . . . **Jack Winninghoff** continues building welded aluminum boats. . . . **Frank Gold** retired from Exxon in 1985 but does some consulting. **Bill Bertolet** has finished 40 years "at the same stand." He has sold the business and will retire in a few months. Bill has no definite plans but he will make a strong effort to improve his golf handicap and to fish the prime trout streams of Vermont. Also, he will do some travel.

Reggie Stoops died last September. He was a self employed consultant in the reinforced plastics industry. An avid transoceanic sailor, Reggie figured prominently in three books written by William F. Buckley, Jr.: *Airborne*, *Atlantic High* and *Racing Through Paradise*. At a memorial service for Reggie, both William F. Buckley, Jr. and Reggie's son, Christopher, gave eulogies. Buckley described an emergency drill rehearsal during a Pacific crossing. Reggie was asked where the lifevests were stored. He reacted as if he had been asked to give a brief definition of the Fourth Dimension. The pause, the slight clearing of the throat, the innocent look of a man accosted by an angular question: but followed by the exhilarating frankness of Reggie's innocent reply.

On the same trip, Chris wrote in his journal, "You find out on a trip like this who you can absolutely depend on." They agreed, the person who was absolutely dependable in every situation was Reggie. Reggie was a critical mass of intelligence, good nature, and composure. He has never complained about anything. Chris talked about Reggie's love of fishing. A month earlier Reggie had found the strength to go fishing. Four nights before Reggie's death, Chris spent the night with him in the hospital. Once that night Reggie said, "I hurt." Two words. In 20 months of combat, those were the only words of complaint that Chris had ever heard him utter. Fighting intestinal cancer, Chris felt Reggie beat death. The cancer that diminished his body never could get through to his spirit.

After our 40th reunion **Malcolm Reed** and his wife, Barbara, tabulated and condensed the responses written by 107 people who attended the reunion. Malcolm analyzed the results and prepared a report for the use of class officers and the Alumni/ae Association. Of 107 responses, 62 people rated the reunion overall with the highest score and 42 more rated it with the second highest score. The helpfulness of committee members was given the highest score on 87 responses. The lectures were given the highest score by 75 responders, and 46 of these people made written comments indicating they particularly enjoyed them. Negative factors were the lack of any seats at all breakfasts, insufficient seats at one dinner, and the rain.

Ed Newdale sold the assets of his screw machine business and retired. He visits his children in Denver. A while ago he detoured to Los

Alamos, N. Mex., and visited **Jules Levin**.

Robert Springmeyer died last year. He was an educational Counselor and was chairman for the Salt Lake City region. . . . **Sidney Tilden** died last year. On behalf of our classmates, I extend our sympathy to the families and friends of these classmates.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

49 40th Reunion

It is January 5 as I write, and in true post-Christmas spirit, **Jack Fogarty** included your secretary on the list of those to receive his annual Christmas letter. Among highlights in the lives of the Fogarty family were three reunions: (1) Curtis Publishing Co. (Peggy used to work for the *Saturday Evening Post*); (2) a Friends General Conference in Boone, N.C., where Jack and Peggy caught up with old friends from their days in west Philadelphia; and (3) Peggy's umtieth at Earlham College in Richmond, Ind. Quoting from his letter: "In an effort to do something 'scientifically useful' with his astronomy hobby, Jack joined the International Occultation Timing Association (IOTA). One frosty night last February (1988) we and four others tried to time a grazing occultation of the moon right here in Columbia (Md.). Observers were stationed at quarter-mile intervals to determine the exact path where the edge of the moon would appear to be 'just grazed' by a particular star. The telescope was set, Jack held the tape recorder, and Peggy had the WWV receiver—and then we were clouded out at the last minute! Peggy is still amazed that there are people who actually want to stand outdoors on a winter night freezing their extremities waiting for some stupid star to wink out. . . ." Jack is a fellow engineer in the Solid State Sciences Advanced Technology Division of the Westinghouse Electric Corp. Defense and Electronics Center in Baltimore.

Thoughtful business leaders in Boston feel that the quality of education in the public schools needs drastic improvement. To that end they have formed an alliance known as the Boston Compact, whose considerable prestige, money, and influence are being used to help the school system. **Bill Edgerly**, chairman of the State Street Bank, is a driving force behind the group. An article in the October 25, 1988, issue of the *Boston Globe* quotes Bill's views: "The question is, is there going to be a determination (by the school system) to go forward and make the commitment to fundamental change that's required in order to achieve the outcomes we all want?" An accompanying chart shows that the percentage of those who dropped out of Boston schools between ninth grade and graduation rose from 36% in 1982 to 46% four years later. On the subject of management, Bill states: "... regardless of how adverse conditions are (in a given school), there are rather astonishing examples of what can happen (for the better) and it is always traceable to what the headmaster or principal did. And I think we should be looking for ways to make that a common experience." On money: "Suppose a school's population were to expand. If a given school, because of its quality, is able to attract more students, shouldn't it attract more budget?" On this point Bill feels progress can be made.

Some of us will need no reminding that on June 6, 1944, thousands of Allied troops stormed the beach in Normandie, France, during World War II. Among them was **Jan Payrot**, who on June 6 will be returning to the scene with countless other survivors for a heart-tugging reunion. We will miss Jan at our 40th, which starts in Boston June 8. But we understand.

Frank Dineen retired from the National Starch Products Co. in Bridgewater, N.J., February 1, 1988, but continued as a consultant for six months. He bought a house on the Oregon Coast and may move there in late 1989.

Gordon Milestone of Potomac, Md. retired last August 3 from the United States Patent Office,

where he was examiner-in-chief.

Walter Seibert writes: "Have now been retired for seven years [he ran Seibert Mineral Service] and recommend it to all! Six children have now increased by 12 grandchildren. We gladly spend about six months a year away from this New Jersey (Teaneck) of New York City. Would like to know where a lot of my Theta Chi buddies are these days. We are off to Florida again for a few months. Happy holidays to all."

Dick Pitler, who has appeared often in this column, writes: "Retired in November 1986 as senior vice-president-tech director of Allegheny Ludlum Corp. Continue to serve on Board of Directors. Am currently serving as president of ASM International, a 53,000-member technical society (formerly the American Society for Metals). Three sons are gone from the nest and wife Jeanne and I are enjoying more leisure, tennis, golf, swimming, and travel."

William Raich has retired after 30 years in research at Dow Chemical Co. He spends six months in Michigan and six months in Florida trying to catch up on all the rounds of golf he missed while working.

Burt Mendlin has retired from the paper industry (Longview Fibre Co., Longview, Wash.). He and wife Polly have four children and four grandchildren. Burt's hobby, which he shares with his wife, is growing rhododendrons. To this end he is chairman of the American Rhododendron Society of Portland Hybridizers and vice-president of the Rhododendron Species Foundation.

Bill Schneider writes that he has just returned from the IAF Conference in India, where he was selected as a member of the International Academy of Astronautics.

Chester Patterson writes that he plans to be at our 40th reunion June 8, 9, 10 and 11. He adds, that "For those who have been holding their breaths, I finished and launched my 46-foot ketch after 14 years of work! NEVER AGAIN."

In the November/December 1988 issue of *Technology Review*, I reported the death on June 21, 1988, of **John H. Wykes** and regreted the lack of details. Information has now been generously supplied by Hal Raiklen, '47, vice-president, Research and Engineering at Rockwell International in California. The class is indebted to Hal for the material he gathered and sent to me that shows John Wykes as a major figure in aerospace engineering. John was the oldest of four brothers, all aerospace engineers at Rockwell, who together accumulated 113 years of service with the company. In 1975, John was chosen Rockwell International B-1 Engineer of the Year for "contributions in the field of aircraft ride quality and specifically for his effort in the successful incorporation of the Structural Mode Control System in the B-1 strategic aircraft design." John's name appears on at least 30 technical papers published both here and abroad. In 1983, John was named a Fellow of the American Institute of Aeronautics and Astronautics.

Ernest Barriere, 69, whose name appeared here last April and July, died of cancer last August 15 at the University of Massachusetts Medical Center on Worcester, Mass. Ernest was an electrical engineer for the General Electric in Schenectady, N.Y., and had lived in nearby Scotia for 40 years. After retiring in 1980, he made his home in Ellenton, Fla., and spent summers in Lanesboro, Mass. He was a past president of the Lions and Kiwanis clubs in the Schenectady area. Besides his wife and mother in Pittsfield, Mass., he leaves four daughters, a son, a brother, a sister, and nine grandchildren. (Secretary's note: On November 5, 1987, Ernest wrote from Florida to say that he was still active in community affairs, the MIT Club of South Florida, and the G.E. El-funs. At the time I lamented that I didn't know what the letters E-L-F-U-N stood for. Ernest later wrote to explain that an Elfun is a member of a group of senior executives at G.E. who promote activities beneficial to citizens of all ages in the communities where the company is located. The class extends its deep sympathy to the Wykes

and Barriere families.—**Fletcher Eaton**, Secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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I. William Millen is still practicing chemical engineering and now biotech in his firm, Millen and White, PC, which celebrates its 20th anniversary this year. He joined his daughter on a photo safari in Kenya last year to celebrate her completion of more than a 3-year stint in the Peace Corp in Senegal. . . . **Robert Fiset**, who has been vice-president, Europe for Martin-Marietta for the past 11 years has been elected to a second two-year term as chairman of the NATO Industrial Advisory Group (NIAG). He is the first American to hold that position. Bob resides in Belgium. . .

Claus Manasse is now vice-president, finance and treasurer of Imclone Systems, Inc., a bio-tech company which moved from Brookline, Mass., to New York City in 1985. His wife is a teacher, and his two children attend the University of Pennsylvania.

H. Thomas Wilson has an active architectural practice in Pasadena, Calif. This involved him in the design and construction administration of the Pacific Missile Test Center facilities and a new 10-story enlisted men's quarters at Long Beach. He and his wife, Rene, enjoyed a return to their own haunts in New England, including MIT this last summer. . . . **Jim Goff**, of the Washington, D.C., area is the program committee chairman for the Cosmos Club. He is currently installing, organizing, and formulating a program in non-technical biotechnology. . . . **John Lane**, after 35 years in industry (his last employer being Singer-Kearfott), has retired to his ski house in Mendon, Vt. He finds many activities—gardening, golf, skiing—all worthwhile and very enjoyable.

We regret to have to announce the passing of two of our classmates since our last column, **Thomas E. Dillion** of Ogunquit, Maine, and **Robert J. Kandel** of New York City.—**John T. McKenna**, Secretary, 9 Hawthorne Pl., 10-H, Boston, MA 02114

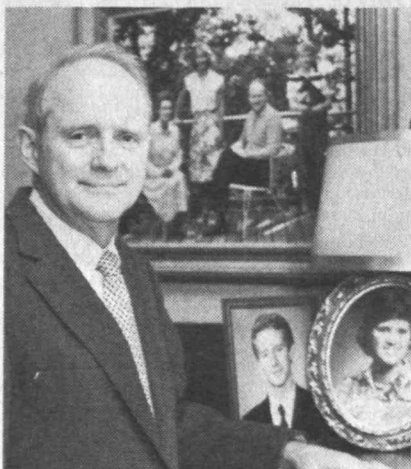
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We have just received a report on the planning for our forthcoming reunion. Our reunion chairman **Harold Glenzel** writes: "We have a large, active, enthusiastic committee that has already started planning for our June 1991 40th reunion. After the formal alumni activities conclude on Friday afternoon at MIT, we plan to provide buses to take us to the Chatham Bars Inn on Cape Cod for the weekend. On Saturday afternoon, sailing, fishing, golf, tennis, sight-seeing, shopping, hiking, bicycling, and just plain lounging around will be available at your option. That night a traditional Cape Cod clambake with steamed clams, lobsters, and all the fixings has been scheduled. Forty reunion committee members (one for each year since 1951) are poised to start work in 1990 on the detailed plans. Watch your mail and this column for more information."

Recently returned from a six-week concert tour in Peoples Republic of China with the New Hampshire Friendship Chorus, **Charles A. Comp-ton** tells of the six concerts in Beijing and Shanghai and some wonderful visits with local church and radio chorus groups. He feels that it was a far cry from the teaching of high school science.

Retired from the Nashua Corp. after 37 years of 4:30 a.m. alarms, **D. C. Whittinghill** feels that it is great to be able to pick one's own projects. . . . Following his retirement from Honeywell in 1987, **Robert M. Lazzopina** is having a great time traveling and helping his two son-in-laws in their printing and landscaping businesses. . . . Engaged in the building of a magnesium plant in High River, Alberta, **Alfred H. Wheeler** is the "chief technical specialist" for the Magnesium Co. of Canada.

Claiming to be "100 years old this year," **Walter**



Fred Lupton, '55

A Good Deed Comes Full Circle

On New Year's Day, Fred Lupton received a phone call from the teenage girl who saved his life. She had kept him alive for 10 or 11 minutes by cardiopulmonary resuscitation (CPR) when he collapsed from a heart attack at the Washington airport last April. When the ambulance and paramedics arrived, she went on her way without leaving her name. Lupton, '55, head of Lupton Engineer Associates in Chattanooga, Tenn., and an ordained Presbyterian minister, has searched for this young heroine for eight months just to thank her.

An article in the publication of the Boston Heart Association persuaded her to call Lupton. The young Bostonian still declined to give her name, believing that one should not accept rewards or recognition for helping others. She is 18 years old and Jewish: her refusal to receive reward or praise for a good deed is a tenet of her religious faith. She is currently going to school to learn to work with handicapped children and drug addicts.

Her rescue of Lupton has given meaning to her life, she said. She had learned how to administer CPR three days before his heart attack as part of a Boston requirement for high school graduation. But as she explained to Lupton, she pondered the meaning of her own life since her father saved her by performing an emergency tracheotomy aboard an airplane when she was three years old. Now that good deed has come full circle. And if she ever needs anything, say the Luptons, "she has a family in Chattanooga."—*Susanne Fairclough* □

Massey explains that in May he celebrated his 40th year in show business to accompany his 60 years of life experience in August. In the fall at the National Theatre Arts Ball, he was awarded an Outstanding Lifetime of Service Award for activities with the Canadian Actors Equity Association. He currently sits on their national council. "How far from engineering and MIT's early experience can one get! My memories are fond, though, of those dear friends I still see at conventions." . . . Recently returned from a three-week sight-seeing and business tour of the Far East including Australia, Hong Kong, S.W. China, and Japan, **Joe Iannicelli** writes that his companies, Aquafine and Impex, are having their best years. These companies supply processing equipment to the booming kaolin clay industry in the U.S. and overseas.

Roy Weinstein addressed the issue of "Big Science and the Budget" in Boston last December as a panelist of the MIT Alumni Association Boston Seminar Series. Roy is a professor and past dean of the College of Natural Sciences at the University of Houston.

Last January 1 marked the 10th anniversary of the second marriage of **Tracy Wichmann**. Having remarried after losing his first wife of 25 years, Tracy feels that he is one of the rare individuals fortunate enough to have two successful marriages in one lifetime. Tracy is a project manager at Hughes Aircraft, where he is currently assigned to run the Military Airlift Command Electronic Warfare Program. This provides support and countermeasures to protect large aircraft like the C-5 and the new C-17 from enemy radar, missiles, and other electronic weapons. He is still into boating and was commodore of the Marina Yacht Club. In 1989, he will be vice-commodore of the Southern California Cruiser Association and rear commodore of the Santa Monica Bay Power Fleet. He won the commodore's trophy in the cruiser navigation contest.—**Martin N. Greenfield**, Secretary, 25 Darrell Dr., Randolph, MA 02368

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Two classmates who have been most generous in sharing news of themselves over the years are **Charles Saltsman** and **Nick Haritatos**. Charles is a vice-president of Raymond Engineering, now a part of Kaman Corp., specializing in weapon safety systems. In his spare time, he sails Long Island Sound and beyond to Cape Cod and, in addition, does wildlife sculpture in a mosaic medium he has developed. A widower for several years, he has three grown sons and two granddaughters, the children of his eldest son, Charles III, '80. The balance of his free time is spent "learning the fine art of housekeeping and single parenting."

Nick continues to be busy doing process engineering work for Chevron, which led last year to a trip to England in January and to China and Japan in December. At home in El Cerrito, Calif., he gardens on his large, steep hillside lot and teaches Sunday School with his wife. His son studies music at University of Chicago, and his daughter is at Johns Hopkins.

Alex Dingee is certainly one of the more entrepreneurial of our classmates. Currently he is president and CEO of Visage, Inc., of Framingham. He most recently had been chairman and general partner of Venture Founders Corp. . . . **Claus Meissner**, who has been retired for two years in Punta Gorda, Fla., says he is interested in contacting anyone to help with promotion of air traffic safety and its technical, administrative, or political aspects. . . . **Gilbert Solitare**, M.D., has received a plaque for having donated ten gallons of blood, an example to inspire all of us. . . . **Steve Sussman** has been named a principal engineer at Mitre Corp., where he has worked since 1976. Previously, he had been a group leader. His specialty is military communications networks.

There are two deaths to report: **Carl Jensen**, of

Eiksmarka, Norway, died in January 1988, and **Jack Jordan**, of Great Falls, Mont., died October 19, 1988. He received S.B. and Ph.D. degrees in chemistry from MIT, worked for the National Bureau of Standards for a while, and was administrative officer of MIT's Department of Chemistry until 1976.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

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In early January, as I write this, I'm thinking about April when you'll be reading it. What a way to wish your life away. I received some letters and a few items from the Alumni Association. Keep filling out those items on your pledge forms because they do get to me.

Carl Swanson writes to say that he was sorry he missed the reunion and hopes more of us can make the 40th. I second that motion. He doesn't say what he is doing but I note, from his address, that he is living in Boylston, Mass. Anyone traveling through might give him a call.

By the way, if there is anyone in the class that you have lost track of and want to get in touch with, call or write the Alumni Association and they should be able to help you out. That might be a great way to stir up some interest in the next reunion.

Marty Wohl, our class president, has moved into his new townhouse in Annadale, Vir. He has been struggling for a few weeks to get it livable, according to his standards. My wife and I stopped by for a post New Year's drink, and he seems to be pretty well settled in.

Robert D. Stalow is in the final year of a second three-year term as chairman of the Department of Chemistry at Tufts University. . . . **H. Newton Garber** is with Merrill Lynch as first vice-president and director of its Management Science Group. . . . **John F. Horning** was recently promoted to vice-president of engineering at Deutsch Metal Components in Gardena, Calif. They manufacture aerospace and marine tubing/pipe fittings and hose fittings along with installation tooling.

Ray Dietz spent a month in Europe with his wife Nancy this summer. He reports that Vienna is fabulous along with other Austrian areas. They were able to live with a German family for two weeks. He indicates that the people were wonderful, the food and wine were great, and the museums were something else. His final comment: "What more could one ask!"

One sad note: **Harry Krimbill** passed away on July 20, 1985, of cancer. Anyone who knew him well may want to write to his wife Jane at 4509 Washington St., Midland, MI 48640.

When and if you are in town (Washington, D.C. area), give me a call and we will try to get together for lunch, a drink, or dinner. I can contact Marty in a matter of minutes and we can make it a miniature reunion. Send me your letters or give me a call. Think *Reunion 93*.—**Gilbert D. Gardner**, Secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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35th Reunion

Our 35th reunion is only two months away. If you haven't yet made your plans to attend, do it now. Highlights include Tech Nite at the Pops on June 8, class dinner at the Meridian Hotel on June 9, a visit with Paul and Priscilla at the President's House on June 10, and adjournment to Nantucket for more festivities on June 11. Y'all come and enjoy the party!

Christmas cards and the holiday season always bring lots of class news. The annual letter from Catherine and **George Schwenk's** cat, Crathern, informs us that the Schwenks did a lot of traveling last year: Florida in February, Cleveland in May, Maine in July and August, Tanglewood twice, etc. George is still buying and selling small companies and running his Boy Scout group;

Catherine continues to run the town meeting, the school district, and the school building committee. The Schwenks live in Mason, N.H.

Elaine and **Rog Griffin** report that he is still working hard at Marine Hydraulic Systems in Lutherville, Md., where he is general manager. The Griffins managed a golf tour of Scotland in June. . . . Varda and **Harry Taylor** write from Israel that Harry is getting more and more involved (timewise) in his marketing endeavors, and Varda is spending some of her time demonstrating microwave ovens. The Taylors and the Griffins both report that their children are all doing well.

From other sources, we learn that **Klaus Zwilsky** has been elected vice-president of the American Society for Metals International and will become president later this year. Klaus is the executive director of the National Materials Advisory Board of the National Academy of Sciences and the National Academy of Engineering in Washington, D.C. He was appointed to that position in 1981, following more than 20 years of very successful research administration in both industry and government.

Jerry Cohen, dean of engineering at Northwestern University, has been appointed a director of the Material Sciences Corp. in Elk Grove Village, Ill. . . . **Tom Henderson**, president and chief operating officer of the Guy F. Atkinson Co. in San Francisco, has added "chief executive officer" to his title and responsibilities. . . . **Michael Deskey**, who practices architecture in New York City, has been retained as architectural consultant by the American Museum of the Moving Image, the first film museum in the United States, located in Queens, N.Y.

Jim Dwyer has established Ventec, Inc., in Marlborough, Mass., a company designed to help university faculty and others develop their inventions and technological advances in the commercial fields. . . . A local newspaper wrote an article about **Phil Rane**, a radiologist on the staff of Hunt Memorial Hospital in Danvers, Mass., and his secret recipe for "stormy chicken," a very spicy dish.

We have several other items, but we'll save them for next issue.—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.**, Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

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Whoops! In my January column, I reported that **Melvin Weiner** had retired from MITRE's technical staff last June. Not so. I misread the page in *MITRE Matters* which listed "retirees," "10 years service," etc. Melvin telephoned me in Sherborn the night he received his *Review* to note that he had finished his 10 years of service but still has some time until retirement. Sorry about that. It's encouraging however that many classmates go directly to the class notes. I'll have to invent some news about some of you and then have you call in corrections—a whole new way of reporting!

It is January as I write this column, so I'll share a few notes from Xmas cards Edie and I received. From the **Fred Luptons**: Jane reports that Fred is doing better than the doctors thought he would, following his heart attack at Washington National Airport last April. (See box facing page.) . . . **Chan Stevens'** dad died in August. Chan and Sally have sold their home, taken the over age 55 tax allowance, and moved to the family farm. They are keeping another house in the city (Mansfield, Ohio) until they decide whether or not they want to keep the farm. The last of their boys is a junior at Tufts, and Chan has promised to check in with me on his next trip to Boston so I should have more to report later on the Stevens clan. . . . **Char and Warren Lattof** report that they have moved back to their old neighborhood, so he has a 5-minute, instead of 20-minute, ride to work.

Dave Brooks sent a nice note to let us know that as of this September he left the consulting firm he helped to form and joined Canada's In-

ternational Development Research Centre as coordinator, environment unit. IDRC is a rather unusual development agency with few counterparts elsewhere in the world. Funded by parliament, it supports research programs in the third world by people working and studying in the third world—the idea being that one gets better research and less distortion if the priorities are set there. He left his old colleagues with great regret—but consulting with none—and says it is nice to be on the other side of the funding/contracting business. The high point of his summer was two weeks of kayaking in the fjords of Greenland. It was a real adventure (all in the good sense) to paddle up to the edge of ice fields and to watch (from a distance) ice bergs roll over.

Ralph Wanger sent his entry in the class' "Final Father Sweepstakes." After raising three fine children from his first marriage, he remarried three years ago. Leah and he now have a 2-year-old daughter, Jenny, and another little girl due in March 1989—at a time when many of us are grandparents, yet. He hears **Stan Barriger** has a second family, too. How many others? In June, Ralph and Leah hosted a mini-reunion in Chicago with the following '55ers and wives: **Jerry Zindler**, **Samuel Goldman**, **Robert Posner**, and **Marvin Biren**. They had three days of feasting and fun, including a Lake Michigan cruise, a tour of the Frank Lloyd Wright studio in Oak Park, a concert at Ravinia, and dancing at the Satin Doll. All seem happy, healthy, and enjoying careers. The Acorn Fund continues to do well. *Forbes* put it on their "Honor Roll" of best mutual funds (top 20 of 700) for the fifth straight year.

I regret to inform you that two more of our classmates have passed away. At this writing, we have only the following information: **Frederick L. Scarf**, July 17, 1988, Sherman Oaks, Calif., and **Henry D. Tomlinson**, June 16, 1988, Jacksonville, Fla.

Keep the news coming.—**Robert P. Greene**, Co-secretary, 37 Great Rock Rd., Sherborn, MA 01770; **DuWayne J. Peterson, Jr.**, Co-secretary, 201 E. 79th St., New York, NY 10021

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Ron Massa is working with the Alumni Association to initiate some activities prior to the 35th reunion. These include local reception for the Class of 56 Career Development Professor in the late spring, mini-reunions in Boston, Chicago, and California, possibly a tent affair at an MIT football game in October for the Boston area, and focusing in on what class gift should be considered for the 35th reunion and on.

Kreon Cyros writes that his annual Facilities Management Conference at MIT and semi-annual course, "Facilities Management for Senior Executives" have been drawing record numbers. His youngest daughter is a sophomore at BU; the two older boys are in the world of work in computer service sales and image processing. Computers seem to effect all of the Cyros.

John Gignac has availed himself to a special early retirement program after 24 years of service with the Polaroid Corp. It proved a difficult choice as Polaroid treated him well and provided challenging responsibilities in manufacturing, research, and marketing. The pension enhancement, however, proved too good to pass up. John plans to work for another 8 to 10 years and is excited about the opportunity of trying something new. He resides in Southboro, Mass.

Sigurd Hoyer-Ellefson is CEO and owner of Linton Roof Truss, Inc., Delray Beach, Fla., a wood truss manufacturer. Sigurd notes that roofs are getting more complicated with less repetition of the same designs and the need to increase equipment-intensive operations. . . . **Dimitri Manthos** is involved with a new software company, Libra Legal Systems, providing service and programs primarily to law firms. He is providing solid support to the Alumni Fund and resides in New York City.



Richard Mateles

Richard Mateles was recently named as a senior vice-president at the ITT Research Institute. He is directing research operations of 450 personnel in Chicago and Bartlesville, Okla. He has been involved with negotiation agreements for the licensing and sale of technology and research programs. Richard received his doctorate from MIT and previously worked for Stauffer Chemical Co. His credentials include more than 100 scientific articles, reviews, patents, and invited lectures.

Anthony Turrissi has been promoted to associate professor of English at the University of Lowell (Mass.). Anthony received a master's degree in English from the University of Wisconsin after earning a bachelor's degree in chemical engineering with us.—Co-secretaries: **George H. Brattin**, 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin C. Gross**, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York City, NY 10020, (212) 512-3181

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Living in Wisconsin—the *real* Midwest—makes me really appreciate the arrival of spring. News of our classmates is also abloom, so here we go. **Irv Stiglitz** is with the Advanced Digital Signal Processing Group at Lincoln Labs where his group numbers 60 people. Irv and Arlene have two children: a daughter Kim, 24, and a son Dean who is a freshman at Skidmore. Arlene has also become an entrepreneur and started her own public relations business.

Ralph Schinzel has been with GTE Communication Systems Division in Needham, Mass., for the past eight years. His work involves systems engineering on tactical telecommunications switches. Previously, he had been in a retail business venture for about 10 years and prior to that had worked for Sperry Gyroscope on Long Island.

Among the more prolific authors in our class is **Jason Taylor**, who has now written six books as well as over 1,000 articles for the trade press on applications of high-tech products. He also conducts seminars for corporate marketing communications personnel on interviewing, writing, and marketing skills. Jason serves as a professor of mathematics at Bentley College by day and at Northeastern University in the evening school. . . . **Howard Salwen** is chairman of Proteon Inc., a leading manufacturer of Local Area Networks. He was recently named a Director of Telco Systems Inc. in Norwood, Mass. Due to international expansion at Proteon, Howard and Laura have recently traveled to Australia, New Zealand, Singapore, and other Asian countries. They have both kept up their tennis game, as we found at the 30th reunion. . . . No sooner did we report on **Pete Hellsten's** outboard racing activities than we find that he has just returned from Milan, Italy, as a member of the U.S. team competing for the World Outboard Hydroplane Championships. At the reunion, Pete and I spent a lot of time talking about outboard racing because my stepfather was a professional outboard race driver in the 1926-1930 era. . . . **Bob Phinney** is still at Princeton where he is in the Department of Geophysics and Geology. He recently spent six years as department chairman (they have a rotating chairmanship system). Bob and Caroline were

at the reunion and we had a chance to catch up on their activities.

Rex Ball is chairman and CEO of HTB, Inc., a leading architectural engineering firm located in Oklahoma City. His firm recently received the 1988 Gannett Foundation Award as "Corporate Humanitarian of the Year." The firm also received the award from the Oklahoma State Chapter of the American Institute of Architects as the "Outstanding Firm of the Year." Rex also received individually the 1988 Governor's Art Award for his long-standing commitment to the cultural climate of the state. . . . Recently, **Ray Danon** left the chemicals business to become CEO of Industrias Reliance Mexico. At the reunion, Ray said he had found the change of industries to be quite challenging. Loretta and Ray continue to enjoy living in Mexico and look forward to hearing from any classmates visiting Mexico City. . . . With snow conditions fairly good, Barbara and **Bill Bayer** have been spending a lot of time skiing at their Stratton Mountain lodge. At the reunion, we learned that their daughter graduated from Tufts and is now getting her M.B.A. at the University of Connecticut. Their son is currently at Tufts in his senior year. . . . Bebe and **Gary Fallick** attended the Pops Concert during reunion weekend with their two children: Mark, 24, and Jill, 22. Currently, Gary is general manager of the Laboratory Robotics Venture at Waters Associates. Bebe is active in politics and has become town clerk of the Board of Registrars in Lexington where she is also assistant treasurer.

Last August, following the reunion, **Pete Peterson** and **Mike Brose** rowed with their respective clubs at the U.S. Masters Rowing Championships in Oak Ridge, Tenn. Rowing for the Cambridge Boat Club, Pete won three gold medals in the 52+ age group in these events: men's quad; men's four with coxswain; and men's double. Pete also placed fifth in the single scull event. Mike rowed with the Mendota Rowing Club (from Madison, Wisc.) and competed in the men's 45+ age group "late bloomer" four with coxswain. Their boat placed sixth out of seven in this event. Although Pete and I had hoped to arrange an informal handicap race between our two clubs, the race schedule was so crowded we couldn't fit it in. . . . After three years in London with the Rank-Xerox Co., **Sars McNulty** has returned to the United States to assume a position as chief engineer, Mid-Range Products and Systems Business Unit of Xerox. While they were in London, Sars and Mary's son, Alan, was at the American School where he was in the school orchestra which played for President Reagan when he visited London. During this stint in England, Mary taught calculus at a school there. Their daughter, Mary, just graduated from law school at New York University, and a son, Brennan, is working at General Motors. . . . That's all for now. Next month we'll have some "stats" from the Class Reunion Questionnaire.—**Mike Brose**, Secretary, 841 Magdeline Dr., Madison, WI 53704

59 30th Reunion

Well, thanks to some notes that a number of you provided to the Alumni Association, we have a veritable cornucopia of information this month. In fact, Collias, like the squirrel in fall, has saved a few for the lean months to follow.

To start, **Allen Ream** tells us that he is enjoying his sabbatical from Stanford this year; this winter he's at UCSD. Tough duty, what? . . . **John Chang** reports that after 20 years at Foxboro Co. he is now with AMTROL, Inc., as director-Pacific Region, making him responsible for operations throughout Asia and the Pacific. John would enjoy visiting other alumni in that part of the world. If interested, contact him at AMTROL in West Warwick, RI, (401) 884-6300. . . . **Peter Luchini** started Luchini & Milfort Engineering in 1983, which offers mechanical and electrical system design for building construction. A Boston office opened in 1988 and, pending a merger, will in-

crease the firm to 35 employees in January 1989.

News of other engineers . . . **Frank Koppelman** writes that he is teaching civil engineering and transportation at Northwestern, where he does research on travel behavior. He also has a part-time consulting business. Frank married Deborah in March 1987 and became an instant parent of two teen-age boys. According to Frank, life is definitely better after 40—and after 50. . . . **George Webb** is at Christopher Newport College. He reports that three of the 10 faculty in physics there are MIT alums. Add to that its proximity to NASA Langley and the MIT folk there and, according to George, the Institute has a fairly heavy influence on many of his students. Also, they use the MIT Design Contests in their design classes. Way to go!

Roger Travis reports (brags?) that he is winning many golf tournaments. Now there is a man who has his priorities straight. Sounds to me like a challenge to the rest of you for the reunion coming up in June. . . . **Allen Domiceli** writes that, unfortunately, he lives in a country (unnamed) where a low profile is preferable. He has his own small firm and is "leading a reasonably happy life with family and friends." . . . **Dick Desper** writes that his job allows him the freedom to pursue his curiosity about polymeric materials. He has also become somewhat of a computer expert and is the systems manager of a VAX. Dick's family is large and has varied interests. His own five children include an EE, a grad student in chemistry, two undergraduates (one majoring in math and another in French and history), and one who is more interested in "working with his hands." Now add to that three more children when Dick married Laura in January 1988. Life is active, but since many of the kids are away at school or on their own, Dick reports that he even has time for some golf with his bride. Are you listening Roger?

And now from the school of science . . . **John Brackett** is at Boston University developing the graduate software engineering program, which is industrially oriented and intended for folks with several years work experience. John had 15 years in the software industry before making the move and enjoys the challenge. He believes that software engineering will be the next major engineering field to open up, and his program is one of a handful in any engineering school. As John says, "Even MIT is likely to include it, I believe, before [the year] 2000." . . . **Louis Cohen** reports that he has been active as an amateur composer and performer since graduation; he is currently preoccupied with synthesized music. Professionally he is involved with the new product quality movement in the U.S., Having studied Japanese methods extensively in Japan and elsewhere. . . . **John McNear** notes that he remarried last spring, to Ann Hamilton Howe. Maybe we'll meet her at the 30th. . . . **Donald Landstrom** writes that he is the project manager for two Gas Research Institute projects involving advanced gas-fired heating/cooling systems.

Three additional notes: **Michael Drew**, M.D., tells us that he is building an orthopedic surgery service at the New England Deaconess. Slow going in the Boston environment. His two eldest children, 16 and 17, are seniors in high school and will be off to college next year. . . . **Steve Parkoff** reports that he is involved in Jewish activities as are his daughters. They are active in Young Judea and have each spent a year in Israel. . . . Finally, **Robert Broder** writes that during the past four years his career has taken an exciting turn. His has become one of the leading security design firms in the Northeast, specializing in correctional facilities. Last year the company led the correctional design component that won the Commonwealth's design/build competition for Boston's Suffolk County Jail. This year it is competing to rebuild the Deer Island prison. Now if the reunion committee is strapped for a picnic site. . . .

Well, that's it. Thanks for all the news. In a month or two we'll gather in Cambridge and else-

where for the 30th. Looking forward to putting some faces with five years of notes. See ya!—**Ron Stone**, Secretary, 116 Highgate Pl., Ithaca, NY 14850, (607) 257-2249

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Some of the many talents of **Susan Schur** recently received well-deserved recognition in Washington, D.C., and Cambridge, Mass. In November 1988, President Reagan presented Sue the President's Historic Preservation Award. Sue's award was the result of the outstanding building and materials preservation achievements of *Technology & Conservation*, a magazine she founded and of which she is the publisher-editor. Additionally, 50 of Sue's oil-paintings were the subject of a recent exhibition at the Andover-Harvard Theological Library. The exhibition, "Passages: A Panoply of Changes," showcased Sue's depictions of the varying faces of nature and the range of human activity through a lifetime. . . . Another of our Course III alums (Sue is Course III) was also recently honored. **Richard Higgins**, a Georgia Tech professor of electrical engineering and director, Microelectronics Research Center, was elected a fellow of the American Physical Society. Richard was cited "for contributions to electronic and microcomputer instrumentation for improved measurements of metals, alloys, and semiconductor heterostructures." Richard came to Georgia Tech in 1987 from the University of Oregon where he was the director of their material Science Institute. Congratulations! . . . **David Richman** was recently named as one of the 13 members of the New Jersey Governor's Roundtable on Superconductivity. The roundtable is developing a plan to define New Jersey's strategy for sustaining leadership in the R&D of superconductivity. . . . The *Wall Street Journal* noted that **Warren Van Genderen** was named chief operating officer of Patten Corp. in Stamford, Vt. Warren was previously founder and president of Yellowstone Basin Properties in Bogeman, Mont., a Patten Corp. subsidiary.

Bruce Silberg sent me the following note: "In the early 1960s, I was a 'weekend warrior,' holding a full-time job as a systems programmer/analyst and competing in Sports Car Club of America-sanctioned events. On May 29, 1965, I was in a near-fatal, one-car accident, destroying my short-term memory. Although I was published in A.C.M.'s SIGPLAN notices 6, 8 (September 1971), my short-term memory difficulty, which managers do not understand, keeps me unemployed." . . . **Edward R. Pollard** is now "Grandpa ERP." Ed recently returned from speaking engagements in Europe and, as of this writing, was getting ready for the Toronto winter. By now, Ed, I hope you are enjoying a spring thaw and your new grandchild. . . . **Howard Hornfeld** wrote from Geneva where he continues his plastics consulting practice. Howard and his wife, Carolyn, are both active in Geneva's Anglophone theater; Carolyn will soon co-produce "Music Man" and Howie is pushing to build a theater for their troupe. . . . From Seattle, Wash., I received word that **Hank Moravec** has "commenced a third career" (Hank didn't tell about one and two) as a general partner in HARGUS consultants on the Italian Riviera where he will be assisting an Italian shipbuilder in the transfer of fiberglass technology to the U.S. Navy.

Keep those cards and letters coming; and if you haven't contributed to the alumni fund this fiscal year, perhaps you could enclose a check to the Alumni Fund with your notes. Thanks.—**Frank A. Tapparo**, Secretary and Class Agent, 15 South Montague St., Arlington, VA 22204

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Robert T. Brady, president and CEO of Moog, Inc., in East Aurora, N.Y., has been recently appointed a director of Acme Electric Corp. of

Olean, N.Y. The news of this was published in the October 18, 1988, edition of the *New York Times*. . . . **Alden T. Foster**, formerly vice-president/ systems division, has been appointed senior vice-president, strategic technology, for Project Software Development, Inc., of Cambridge, Mass. We learned of this in the *Boston Sunday Globe*, October 9, 1988.

We have word that **A.T. (Funky) Funkhouser**, our class specialist in *deja vu* and other ESP experiences, has returned from a "lovely five weeks in Australia" this past summer (I assume it was winter down-under). He gave a lecture tour on *deja vu* and dream interpretation during his visit, and had the opportunity to meet some of the indigenous folks. His lectures were well-attended and seemed to create a lot of interest in his subjects. He also got to visit EXPO '88. If we had been able to attend his Australian lecture tour I suspect it would have been *deja vu* from our 25th reunion. Funky stirs up the discussion between the skeptics and true believers in ESP. Since I've been there, I'm one of the latter, but I know we have lots of skeptics given the nature of our training at MIT. Remember that Funky got his original training in physics before moving into the metaphysical realm in Bern, Switzerland. Perhaps he could share some enlightenment about the religious visions in Yugoslavia.

Steve Brams dropped a note to inform us about his latest book with D. Marc Kilgour, *Game Theory and National Security*, published by Basil Blackwell in April 1988. In terms of new books, I suspect that most of you may have missed *Introducere in Economia Conservarii Energiei* (in Romanian) by **H.N. McCarl** and two co-authors published by SID in Bucharest in 1988. You might find the American version *Introduction to Energy Conservation Economics* available in English at some time in the not-too-distant future.

Barry Belkin informs us that he is now president of Daniel H. Wagner Associates, a Philadelphia area consulting firm for operations research, mathematics, and software development. His organization is developing tactical decision aids, carrying out systems analysis, and conducting requirements and vulnerability studies for the U.S. Navy, its principal client. . . . **Jerome Winston** writes from down under that he has completed 6 months attached to the Australian Commonwealth Government as a consultant in program research, monitoring and evaluation. Jerry is with the Department of Mathematics and Computing at Phillip Institute of Technology, Bundoora, Victoria 3083, Australia.

We take some pride in announcing that **Carl Wunsch**, of MIT, has been awarded the Bedford Institute of Oceanography's 1988 A.G. Huntsman Award for his contributions to understanding the link between oceans and the global climate engine. Carl is recognized as a leader in modern physical oceanography, and it should come as no surprise that his work may help us to better evaluate global atmospheric warming and the potential impact of the Greenhouse Effect. According to the news release from the Canadian Department of Fisheries and Oceans, "It is largely through his vision and perseverance that the oceanographic community for the first time—during the 1990s—will take part in the most ambitious oceanographic research program ever—the World Ocean Circulation Experiment (WOCE)." The WOCE is a 10-year study of the role of the oceans in world climate.

Well that's about it from your man in the Deep South. Don't forget to drop us some information on your accomplishments, family news, and/or greetings from some exotic place like outer space or the mid-ocean ridge. Write to:—**Hank McCarl**, Secretary, P.O. Box 352, Birmingham, AL 35201-0352

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It is a rare pleasure to gather this column almost entirely from letters you have sent. Let's get to

them. **Kirit Sheth**, writing from Bombay, sends regrets at not being able to attend the 25th reunion, "due to unavoidable circumstances. Life still is good, challenging and satisfying." Kirit heads a group of companies called Hakotronics, which does automatic test and call-distribution equipment, and speech and data networks. They hope to receive a contract to modernize India's air traffic control. Kirit and his wife Nalini have an only child, Hema, who is 15. She wants someday to study at MIT. Kirit heads the Bombay IEEE section, and is busy organizing next November's regional IEEE conference, "Information Technologies for the 90s."

Ron Rueckwald is now general manager of the Aeroproducts' Division of IMO Delaval, Inc. He and his wife Dorinda live in the college town of Oberlin, Ohio, and she runs a small company they started. Dorinda also breaks, trains, and shows quarter horses. (Ron, dare I ask what they do with the other three quarters of each horse, or would only a city boy like me ask that?) They are both enthusiastic sailors. Ron proudly announces that MIT has accepted their son Eric into the class of '93.

From Kensington, Md., **Mark Epstein** brings us up to date: three years ago he left DoD to join a group of other MITers and start QUALCOMM. It specializes in high-tech communication terminals. Their hottest product is a two-way satellite communication system for cross-country trucking, allowing real-time fleet management. Mark's eldest son, Paul, goes to college in the fall; and Jeff, his other son, is in the fourth grade. To stay in shape Mark plays squash and rides a bike.

Calvin Yee reports his daughter Wendy is now a freshman at MIT. He is active with the MIT Education Council, which he enjoys. He is also busy as the principal of a micro-age store in Columbus, selling business computer systems and services. . . . *The Wall Street Journal* related that Apollo Computer of Chelmsford, Mass., has promoted **Mike Greata** to vice-president/chief technologist.

Frank Cocks has some exciting news: he expected his space shuttle experiment on ultraviolet, reactive metals to go up in January 1989. The results are to be written up in *Omni*, which has a circulation of some 800K. "This means that more people may read this one article than all 100 of my other publications." Frank is at Duke University, in Durham, N.C.

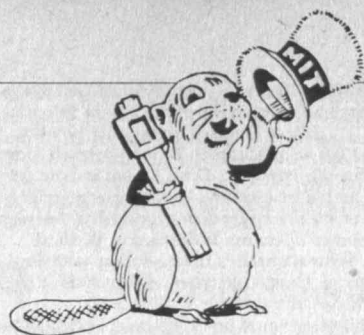
My wife, Linda Marsden, and I have set up a new company called Training to Go ("We Deliver"). We will provide training and consulting services in human resources' development (by Linda) and computer productivity (by yours truly). Our daughter Julie is just starting to take solid food. My son Gary is waiting for grad school admission results from, among others, MIT. Keep sending those cards and letters; don't let me just read about you in the *Wall Street Journal*.—**Phil Marcus**, Secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301-750-0184)

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25th Reunion

Hi! If you haven't done so already, get your reservations in soon for our 25th reunion. The program looks terrific.

Your secretary's diverse reading habits turned up a couple of items. . . . From a Colorado business monthly comes news that **Mark Barron** is president of Ford Microelectronics, a wholly-owned subsidiary of Ford Motor Co. located in Colorado Springs. It supplies integrated circuit technology items for aerospace and automotive applications. After graduating from Course VI, Mark earned a master's in electrical engineering and a Ph.D. from Stanford University. Prior to joining Ford, he was vice-president of DXY Corp. . . . *Life* magazine and the *Washington Post* both reported that **Doug Hoylman** won the national crossword puzzle championship in 1988. Doug lives in Chevy Chase, Md., and is an insurance actuary with GEICO.



To alumni who entered with the Class of '64 but graduated at a later date: Please send a biography (photo optional). You're welcome to come to our reunion. Get in touch.—Emma Root, '64, 201 W. Main St., Westboro, MA 01581.

The rest of the news comes from Alumni Fund envelopes. **Charles Abzug** is living in Randallstown, Md., and working in computer science in the Washington area. . . . A bit further afield is **Sam Taub** who has lived in Paris, France, since 1970 and is director of marketing and systems engineering with Storage Technology France. . . . In the United States for 18 months from France is **Bud Boring**, director of training for Citicorp headquarters in New York developing a real estate finance training program for Citicorp's worldwide real estate lending activities. The Borings have a house under construction west of Paris which they will move into when the New York assignment ends this summer. Bud reports that readaptation to a U.S. lifestyle and working a few thousand miles closer to corporate headquarters has been interesting.

Arie Kurtzig writes from Los Altos Hills, Calif., to say that he is now a full-time student, in the first year of a four-year Ph.D. program in psychology at the Institute of Transpersonal Psychology in Menlo Park. . . . **Rev. Frank Carpenter** received a fellowship from the Massachusetts Historical Society for research on William Ellery Channing and his wife's family fortune. Channing was the founder of American Unitarianism. Frank is a minister in the Unitarian Church.

Louise and I are hoping to see many of you at the reunion. Please bring your news items.

—**Joe Kasper**, Secretary, 3502 Idaho Ave., NW, Washington, DC 20016

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Tom Ostrand sent a long note about his recent doings. Tom's still working at Siemens Research Labs in Princeton, N.J., in software engineering research. His wife, Elaine Weyuker, is a tenured associate professor in the computer science department at New York University. Tom and Elaine's first daughter, Rachel Carla, was born in February 1988 and Tom reports that she's the most beautiful and delightful baby there ever was. Tom also says that she's changed Tom and Elaine's lives and "it's wonderful." Tom also reports that in September he and Elaine collaborated on a paper that won the best paper prize at the Pacific Northwest Software Quality Conference.

Andrew Tanenbaum writes from Amsterdam that his rewrite of UNIX called MINIX was released in January 1987 and that it has since become something of a cult item. He says that there's an electronic newsgroup on Usenet devoted to MINIX and that thousands of people all over the world are continuously playing with and discussing MINIX. Andy's comment: "Lots of fun." . . . **Mike Hester** sent a brief note that he's still with Lockheed after all these years, and is currently managing a scientific data center at a

currently managing a scientific data center at a Research and Development facility in Valencia, Calif. . . . **Steve Deutsch** writes that he's the proud father of Elizabeth Burnat Deutsch, born October 10, 1988. . . . **Dave Barber** is now president and chief executive officer of Autographix, Inc., of Waltham. Dave previously had the same position at Spectrum Industries in Bedford. . . . **Dick Schmalleensee** is the co-author with Paul Joskow of *Markets for Power: An Analysis of Electrical Utility Deregulation*.

A bit of personal news: I'll be spending February through April at the Harvard Business School's Program for Management Development, courtesy of Digital. This column is being written in mid-December, and I'll probably get another out in January (May 1989 issue). So you should probably expect a "hole" in the column from June through August of 1989 and you can always blame Harvard. I'd still like to get a replacement at the reunion if not before.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

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Judith Perrolle is now an associate professor at Northeastern University in Boston, and an officer of the environment and technology section and the science, knowledge and technology sections of the American Sociological Association. She is doing research on the social impact of computers—much of it caused by the rest of the class. . . . **Ken Estridge**, the founder of the Joy of Movement Center dance studios, has begun to franchise his operation in the New England area. . . . A fellow physics major, **Ted Gull**, writes that his son is now in the Class of '92. Ted is working at Goddard Space Flight Center as an astronomer. Nineteen hundred and ninety should be a busy year for him as the Astro Mission (he is mission scientist) and the Hubble Space Telescope will be launched by the shuttle then. He often sees **Rodger Thompson** and **Don York**. He reports that 10 classmates are active in astronomy and astrophysics.

Norman Fainstein has been dean of liberal arts and sciences at Baruch College (CUNY) for the past two years. . . . **Stuart Nemser** took a leave of absence from DuPont and spent a year in Israel working at the Weizman Institute. He says it was a fantastic experience for the whole family. He has since relocated to DuPont Canada in Toronto. . . . **Barbara L. Pollack** has been married to Carl Uhrmacher, '64, since 1964. Their son, Mark, was born in 1972. They plan to adopt two boys from Korea shortly. She has served as president of CARL-TECH Associates, a hazardous materials consulting firm, since 1985. . . . **Bill Cain** celebrated his 10th anniversary at Execucum Systems Corp. in Austin, Tex. He and his wife, Britt, have been married for 17 years, and have two children.

As for me, my two daughters are wonderful, and life as a computer consultant in the Boston area is always exciting. I hope 1989 is treating you all well.—**Jeff Kenton**, Secretary, 7 Hill Top Rd., Weston, MA 02193

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As I write this, it is a snowy New Year's Day in Washington, D.C. By the time you read this, most of the winter should be a fading memory.

Our class hero of the month is **Tom Griswold**, who wrote a long, newsy letter which I can only excerpt here. When last we heard from Tom, he was about to be laid off from the Kentucky Energy Cabinet. Fortunately, a couple of last-minute resignations gave him a reprieve, although his organization has been decimated. Tom also just received his certification from the American Institute of Professional Geologists. "I realize that I have been 'certifiable' in various senses of the word, but now I can prove it," he writes. Such certification is not regarded as highly as state

registration, but Kentucky does not have state registration for geologists. Tom's son Scott just celebrated his first wedding anniversary and is working on Shadwell horse farm, which is owned by the ruling family of Dubai. Tim describes their customized 747, which has been modified to allow it to land at the local airport, Bluegrass "International."

Tom also describes some of his recent recreational activities. I was particularly impressed by his descriptions of the waterfowl to be seen from his window at work—blue heron, kingfishers, Mallard ducks, and Canada geese. Sounds wonderful. He also describes a visit to Cumberland Falls State Park with Rebecca, his 'significant other,' where he saw a moonbow, a rainbow-like effect caused by the reflections of the full moon off the mist at the waterfall there. Apparently, that is the only place in the northern hemisphere this phenomena can be seen, and the only other place it occurs is at Victoria Falls in Africa. Finally, Tom mentions a visit to Washington, D.C., where he saw the Vietnam Veteran's Memorial. He reports being quite moved by it. As a resident here, I agree that it is one of the most effective monuments in a city that crawls with them.

Our other reports are briefer, but no less important. . . . **Paul Taylor**, acting executive director of the Los Angeles County Transportation Commission, is to be congratulated for receiving the American Society of Civil Engineers' 1988 Frank M. Masters Transportation Engineering Award. The award recognizes his contributions in establishing and directing the Los Angeles County Transportation Commission responsible for building a 150-mile public rail transit system in the Los Angeles area. . . . In 1984, **Ronald Burd** became president and CEO of the Devereux Foundation, the country's largest not-for-profit mental health treatment organization. With facilities all around the country and headquarters outside of Philadelphia, Rob reports, "My wife, Joyce, and two boys—Josh, 10, and Zach, 7—are finding that W. C. Fields was off base."

Dixon Cleveland, vice-president of LC Technologies in Fairfax, Vir., is developing a computer that a disabled person will be able to operate completely with his or her eyes, no hands required. . . . **Richard Scott** reports that he is now working in the Engineering Publications Department at Stratus Computer in Marlborough, Mass. "It's a great place to work," he writes, "with many ex-Multicians."

We have two news items from academe this month. First, **Thomas Romer** is spending the 1988-89 academic year on leave at Stanford University. . . . Secondly, **Harvey Lapan**, professor of Economics at Iowa State University, is spending the same period as a senior staff economist in international economics at the Council of Economic Advisors, Executive Office of the President.

We also have two reports from classmates returning to the U.S. after stints abroad. **Platte Amstutz** returned to the U.S. recently after 13 years in England, Germany, and Switzerland, shifting from banking to the other side of the desk in corporate finance. He now manages the pension funds of NCR Corp. and calls Dayton, Ohio, home.

Aaron Kleinman writes, "Having returned from three years living and working in Israel, still in medical electronics marketing, my wife and I set up a company to market and service Israeli (and other offshore) medical products in the U.S. and Canada. Three years after that, I find myself only peripherally involved in medical electronics and spending most of my time and energies in proposing and developing conservation management systems for utilities. It's sort of a pleasure to be back to real engineering and to my family (now numbering three) and wife."

Finally, a nice compliment to the reunion organizing committee from **Dennis Noson**: "Thoroughly enjoyed being back in Boston after a 20-year absence; the Class of 1968 officers and friends did a great job of organizing and welcom-

ing. Congrats." Now, with an endorsement like that, I hope everyone comes to the 25th!—**Gail and Mike Marcus**, 8026 Cypress Grove Lane, Cabin John, MD 20818

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20th Reunion

You will be reading these notes only a few months before our 20th reunion in June. Remember, it's not too late to sign up! I recently heard from one die-hard non-attender by the name of "Rick" who will be joining us this time. No excuses this time folks—even if you can't remember faces and names or are embarrassed by your early 40s you don't have a spare \$1 million to give to the Tute. Please be with us June 8 through June 11. End of promotion, and on with the notes.

Richard S. Gawlik has been appointed by M/A-COM, Inc., of Burlington, Mass., to vice-president and general manager of its Microwave Power Devices Division. The division is located in Hauppauge, N.Y. Richard's previous roles at the company have included vice-president and general manager and operations manager for Radar Systems. Prior to joining M/A-COM, Richard was operations manager for Exxon Enterprises Solar Power Corp. . . . **William T. Stewart** of Zanesville, Ohio, writes that he attended the 75th anniversary of his fraternity, Beta Theta Pi. He says that "the current students seem to be well-rounded, intelligent young people. And visiting Boston again was great fun." . . . **Doug Frost** recently moved from Yale Medical School to Harvard Medical School and the Massachusetts General Hospital, where he is now an associate professor in the Neurology Department. He writes, "We're living in Marblehead and looking forward to life on the water." . . . **Mildred A. Hastbacka** writes that she has been back in Massachusetts for five years after spending 10 years in Connecticut. Currently she is a market manager for a variety of industrial chemicals at Morton Thiokol in Danvers, Mass. "The job is a wonderful fit and so is being back in this area," she adds.

John R. Selin is still with Raytheon "but transferred to the new monolithic microwave center in Andover, as MMIC design manager heading up the GaAs (gallium arsenide) design group." . . . **William P. Bengen** says that he is currently "back-to-school to earn certification as financial planner, then on to M.S. in financial services. Opening my own practice from my home in the San Diego area. Enjoying a life-long dream of a tennis court in my own backyard. Spoke to many '69ers during spring telethon—a great experience. How diverse the MIT seed!" . . . **Sanford J. Asman** moved to Atlanta with wife Sheryl and children Greg, Ilyssa, and David. He is now patent counsel, North America, for Schlumberger Industries. The October 19, 1988, *Wall Street Journal* notes that **Roy W. Haley** is now executive vice-president for administration of the American General Corp., Houston, Tex.

Frederick W. Young of Annandale, Va., writes: "In hopes of seeing all the guys I lived with as an undergraduate, I am planning to attend the reunion celebrating the 100th anniversary of the Phi Gamma Delta fraternity at MIT. I hope that other '69 Fijis will attend as well. The reunion will be held in Boston, April 20-23, 1989." . . . **Mark B. Lively** has become treasurer of the MIT Club of Washington and has gotten to know **Smith Wood**, the former treasurer and fellow classmate. Mark writes, "At the annual meeting where I was elected, I talked extensively with **Kathy (Kanarack) James**. She told my wife her version of being stuck with me and the rest of the concert band on a bus from D.C. to Boston for 36 hours during a blizzard in February 1969." Sounds like a likely, lively story to me.

No, you are not seeing a misprint in the address below. In December 1988 we moved from the 250-year-old farmhouse at #183 Woodhill-Hooksett to brand-new digs that we constructed on a 4.5 acre wooded patch just down the coun-

try road—our shortest move yet: 1200 feet! At last I have a custom designed writer's study, not a basement but on the second floor. When I need inspiration, I can look down into the front yard into my very own babbling brook. How fortunate can a guy be!—**Eugene F. Mallove**, Secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03301

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Joseph P. Diliberto III has joined Unisys in Flemington, N.J., as an activity manager for Workstations and Terminals Engineering. . . . **Michael W. Dickens** is now vice-president of Customer Products and Services at Alliant Computer Systems Corp. in Littleton, Maine, after having been marketing manager. . . . **Timothy W. Gilmore** is slowly being forced to consider retirement from the Old Puget Sound Rugby Football Club but otherwise is doing fine. . . . **Paul Doherty** is a staff physicist and a teacher in the Teacher's Institute at the Exploratorium in San Francisco. He has been there for three years. In addition to designing and building exhibits, he instructs physics to high school physics teachers.

Michael H. Prager has married Juanita Remien after having met her at the 10,000-foot-level on Mt. San Jacinto in California. They moved to Norfolk, Vir., where he is now assistant professor in the Oceanography Department of Old Dominion University and has recently purchased a home. . . . **Samuel Fuchs** is working at SH&E, an aviation consultancy boutique and continues to "ride" the computerized reservations and distribution wave around the world. . . . **Mary Ellen Conway** does medical reporting for the ABC affiliated television station in Houston, Tex. Her stories are also fed out to all the ABC stations in the United States. She is pleased to see contacts/patients come to Houston for procedures and leave feeling better.

Gregory Lewis is a deputy chief of operations for the Research Projects Office, Air Force Flight Test Center, in Edwards, Calif., which includes flight testing the F-15 short takeoff and landing maneuver. . . . **David McIlwain** inquires of this writer as to what it's like running a bar and grill "on the side" while practicing law? My reply is that after designing, building, and setting the staffing levels, pricing and menus, etc., I'd rather practice law, except on St. Patrick's Day when bartending is a fine event. Thank you.—**Robert Vegeler**, Secretary, Beers, Mallers, Bachs, Salin & Lamore, 2200 Ft. Wayne Bank Bldg., Ft. Wayne, IN 46802

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Richard J. Hawryluk of Princeton University has been named a recipient of the American Physical Society Division of Plasma Physics' Award for Excellence in Plasma Physics Research. . . . **Edward J. Caramana** has recently become the Sherdi Rouzer Professor of Physics at New Paris Polytechnic Institute. He is continuing research in magnetic fusion at NPPI with his longtime friend and colleague Professor C.K. Rowdyshurb. . . . **Barney C. Black** and his wife Helena had a son on August 16, 1988, weighing 10 pounds. . . . **Laurence Peters** writes, "After 11 years in L.A., Carea and I have returned to Boston and settled in Wellesley with our son Jacob (10) and daughter Jessica (7). My law firm, Laurence Peters & Co., now has offices in Boston and Los Angeles and continues to specialize in representing Australian and other Pacific-based clients in connection with U.S. businesses and investments."

Nancy Lieberman Rosenfield and her husband Don, MIT '64, live in Lexington, Mass., with their three children Jennifer (14), Todd (10), and Adam (2). Nancy is working as a software engineer at Data Resources in Lexington and Don is on the faculty at the Sloan School at MIT. . . . **Peter V. Hwoschinsky** was recently appointed manager of FAA's rotorcraft technology office, responsible for

rotorcraft research and the new initiative into development of a civil version of the tiltrotor aircraft. . . . **John Calcagni** is director of the Air Quality Management Division in EPA's office of Air and Radiation. He is enjoying his work, his wife, and children and life in general in Cary, N.C. He is anxiously awaiting a new administration in Washington. He says, "Here's to Cleaner Air in America." . . . **Ken Weisel** married Pat Jenkins (Mills '80) on September 4, 1988. They bought a house in Roseville (near Sacramento) where he is the City of Roseville's electric utility director.

Kathleen F. Jones writes: After a year in Ghana in the Peace Corps and 13 years in Seattle, I am now in Hanover, N.H. I am married to Don Perovich and have two children Laura (5) and Carlyn (3). I work part time at the Corps of Engineers Cold Regions Lab in atmospheric icing. . . . **Tom Derby** writes: "Enjoyed a great 1988 in my first year as a manufacturer's rep for Emerson Computer Power, the world's #1 manufacturer of uninterruptible power systems and related equipment. Thirteen-year old Tom IV has ambitions to become MIT's first four generation graduate (Tom Sr. in '21, Tom Jr. in '43, Tom III in '71). Nine-year-old Jayna may also pursue MIT when the time is right. . . . **Stanley S. Kask, Jr.** writes: "After over two years at the Department of Transportation, I returned to NASA in Washington as the deputy assistant associate administrator for personnel and general management. The fancy title means I'm responsible for developing human resources management policy and allocating staff resources for NASA's nine installations." He says he hasn't much time for golf, but he and his wife stalk trophy fish for their vacation home in Chincoateque Island, Va.

Leonard Tower, Jr., is taking care of the lawn on a pedal-powered lawn mower and working hard for the free software foundation. . . . **Larry Appleman**, '76, writes: Your classmate **Brough Turner** and his wife Juniper Russell, '74, were guests last month at the wedding of David Abrams, '76, to Annkathryn Goodman.

The MIT Class of 1969 is having its 20th reunion on the weekend of June 9-11. The reunion committee has invited our class to attend. Although plans were not finalized as of this writing, the reunion will involve a dance/dinner on Friday at MIT, a lobster bake at Briggs Field on Saturday, a formal party at Endicott House on Saturday evening and a brunch on Sunday. Call Ms. Eliza Dame at MIT (617) 253-8230 for details.—**R. Hal Moorman**, Secretary, P.O. Box 1808, Brenham, TX 77833

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It's Christmas Eve, and all through the house. . . . **Steve Hansen**, the supervisor in Bethlehem



Steve Hansen

Steel's Steel Products Division, was awarded the 1988 Grossman Award by ASM International for a paper on a theoretical model for design of high-strength steels. . . . **Nick Hamisevicz** is still at MITRE, while wife Anne is a permanent fixture at the law firm of Miller and Chevalier.

Christis Demetriou passed away after a long illness this past June. He had been living in Cyprus, where he had created a large edible oils

business, one of Cyprus' biggest companies. Christis left behind him two sons, ages 7 and 2.

I trust you all had a jolly set of holidays and Ruth and the kids and myself extend to you all wishes for a happy new year. Write!—**Robert M.O. Sutton, Sr.**, Secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

74

15th Reunion

By the time you read this, your humble scribe will be neck-deep in his fraternity's 100th anniversary reunion, along with fellow classmates **Stephen Nuding**, **Tim Hult**, **James Andrew**, **Dennis Huber**, **John Hurd** and **Rod Taft**. Hmmm . . . there were 20 of us. Where are the rest of you? Actually, I know where some of you are. Sue and **Steve Jordan** are expecting their third in April. And what about the other 12, hmmm?

Norman Mazer writes of self and kin. He's been back in the States (from Switzerland) since July 1987. They call him the "principal scientist" at Thera Tech, Inc., in Salt Lake City, where he is also an adjunct associate professor of pharmaceuticals at the University of Utah. He and Marion boast of their three daughters: Angela, Laila, and Adina.

The mail box produced not one, not two, but three letters from classfolks this month. The first in was from **Frank Gulla**. It seems Frank never picked up the computer habit while an undergrad, telling his fraternity brothers, "I will learn about computers when I have to." That's what happened, too. He's now entering his fifth year as supervisor of the Aqualon Worldwide Technical Facility and also is the system manager of the technical computer system. He and kids, Sean and Beth, are living near Richmond, Vir.

Naomi Markovitz is teaching high school math in Jerusalem. According to the rules of their "new curriculum," 10th graders start calculus and linear algebra, moving into vector algebra and geometry in the 11th grade. . . . From even further away, comes word of **Robert Batzinger**, who's presently traveling around Asia as a computer consultant for the United Bible Societies. His return address puts him at home in Thailand. . . . As of this writing, **Edward Montes** was anticipating his marriage in late December to Ruth Jaure. Hope it went well. The wedding was to take place in San Elizario, Tex. Edward works for Relational Technology, Inc., as technical support manager. . . . **Alan Carr-Jones** and **Juniper Russell** were spotted by **Larry Appleman** at the wedding of David Abrams, '76, in early December.

Larry Eisenberg says he "broke down" and wrote me a letter. This is not the attitude we want to engender, children. Think of writing your secretary as "fun." Larry says he and **Christine** are doing well in Madison, Wis. Their son Eric, now 10, recently had a letter published in the *New York Times*. Larry has left the Wisconsin Department of Administration behind after 12 years and jumped to another part of the state government, the University of Wisconsin. His official title is associate vice-president for the University of Wisconsin system, and he details in his letter what his duties are. In a nutshell, he is energy, purchasing, and property czar. He says the nicest thing about the job is he is finally getting to use all the things he needed to learn to get his urban studies degree at MIT. He just treats each of the 26 campuses as a little city. "Please pass on my best wishes to other Class of '74ers and all of my friends from Burton-Conner days." . . . Me too.—**Lionel Goulet**, Secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

75

We have a healthy column this month: **David Jesich** is still working for Exxon in Saudi Arabia and has become quite active in sailing. He participated in the 1988 Laser World Championships

which were held in England last August. Says David, "Needless to say, the water was a bit colder than what I was used to here in Saudia Arabia." Sounds like some sailing improvements may be in order. . . . **Jeff Bokor** finally bit the bullet and wrote to me after all these years of intending to but never quite getting around to it (like most of the rest of you louts). He's a department head at Bell Labs (what is this world coming to?) and works on ultrafast laser research. . . . **Scott E. Denmark** is a professor of chemistry at the University of Illinois, Urbana-Champaign. His specialty is synthetic-organic chemistry. . . . **Alan B. Lekof** has become senior vice-president of finance and corporate development of Grid Systems Corp. in Fremont, Calif.

Saleh Daher Jr. writes: "My consulting practice in loan sales is getting off to a good start. I signed up my first client in September and that engagement has kept me busy 80 percent of the time since then. I'm expecting a second contract soon. New capital guidelines for banks has caused many institutions to look at selling their loans and thus created a need for experts in the technology of loan sales." . . . **John Eidinger** has transferred from California to Texas—Cow Town, Fort Worth. He's still working for Impell Corp. and is learning to say "Hi, y'all," slowly. John is managing the Structural Mechanics Division, still trying to learn a bit more about engineering. He's engaged to Gloria, but hasn't set a date yet. . . . **Steve Slesinger** writes: "Shelly and I decided to 'go for it.' We now have two kids. Latest addition: James Burton."

For your reading pleasure, I reproduce a nice note I received from **Sanford (Furd) Krasner**:

"Well, it's been an exciting year here in Pasadena. In February 1987, I married the former Susan Avery—best man was erstwhile third Easter, Harry Lee Gearhart, '76. We spent our honeymoon romantically, driving to Washington, D.C."

"In Washington, I worked at NASA headquarters as a 'detailee' from the Jet Propulsion Lab. We were trying to persuade NASA and the Office of Management and Budget to start the Comet Rendezvous/Asteroid Flyby (CRAF) project, the first of a proposed set of outer solar system missions. We were unsuccessful, another casualty of the deficit and the post-Challenger era. The job did involve some interesting travel, including a lovely trip to Holland and Austria."

"Having failed to single-handedly resurrect the U.S. planetary program, I returned to JPL to work on the fourth annual new-start proposal for CRAF. At this writing, the jury is still out. . . .

"This past February, I returned to the Institute as a member of the Battling Beavers of Caltech, to contest the varsity hockey team for the coveted Beaver Bowl. Unfortunately, I broke my leg in the first period (yes, that was me thrashing on the ice). Caltech, demoralized by the loss of a crucial part of the defense, went down to ignominious defeat, 13-0."

"In the category of more successful endeavors, Sue gave birth to Sara Lynne, the cutest member of the MIT class of 2010. (Of course, that's an objective appraisal.) May you all live in interesting times."

Roger White and wife Sue sent me their family newsletter—very impressive thanks to desktop publishing. They reside in Salt Lake City with their four children, Altair, 9; Heather, 7; Adrienne, 5; and Roger III, 3; not to mention their white German Shepherd, Sargon; and their five cats, Fluffer, Wabash, Moonbeam, Shasta and Jinx. Roger has become Novell's "Chief Mac Wiz." In June, Novell announced a major new extension of their product. The extension, called NetWare for Macintosh, allows Novell's NetWare product to interconnect not just IBM-compatible computers, but Apple Macintoshes as well. To help this new capability be accepted rapidly by those that develop programs for the Macintosh, Roger has been appointed Chief Mac Wiz. Roger has been all over the country attending trade shows hawking NetWare.

Alex Pankow moved to the Cleveland area of

Ohio over a year ago from Washington, D.C., to work for Progressive Insurance Cos. He is management information manager for the Transportation Division. He insures "truck fleets like the '18 wheelers' you see on highways." He had a third child a year ago, Joseph, who was born on his wife's birthday. Alex also has two girls, Natalie and Katherine. Natalie is five and has started kindergarten and is thoroughly enjoying it. Alex had hoped to continue involvement in MIT's Educational Council but the number of applicants is much lower in the Cleveland area so he hasn't been able to interview any applicants. What does this say about Cleveland?

I heard from **Stephen Chapman**, CEO of Heritage Associates and Affiliates, a Boston-based real estate development and management firm. According to his firm's brochure: "As founder of Heritage Associates and Affiliates and managing partner of the cornerstone affiliate, Heritage Associates, Mr. Chapman has extensive experience in the various aspects of commercial and residential real estate financing, development and management. He has guided Heritage Associates since its inception in 1978 and his leadership has contributed greatly to the growth and success of the firm during its evolution from a single owner-manager entity to the organization of affiliates that exists today." Recent projects include 320 Congress St., a "downtown acquisition" purchased for a cool \$9.575M and Sundial Center, a 360,000-sq. ft. commercial/industrial development in Manchester, N.H. No wonder I haven't heard from you in so long—I'd say you've been rather busy. Congratulations on your successful endeavors and mucho thanks for dropping your old class secretary a line.

Let's hear from more of you.—**Jennifer Gordon**, Secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036

76

My pleas for mail have finally paid off a bit. **Peter Wolczanski** has been named a finalist for Union Carbide's 1988 Innovation Recognition Award. This is an award for significant, innovative academic achievements in catalysis research. He is one of seven. . . . **Jeslie Charmak** writes: "I finally got around to two of the items on my college wish list (which is ever growing)—I took a class in parachuting (and did a 'static' line jump from 3,500 feet) and I'm getting advanced Scuba diver certification (NAUI Rescue Diver). Anyone else doing something 'different'?" . . . From **Jeffrey Held**: "Our firm, Network Strategies, was acquired by Ernst and Whinney. As a result, Charlie Joyce, '56, Dave Passmore, '77, and myself became E & W partners." . . . **Beth Kleiner** is "...living in San Mateo with my husband Brian Kirschner, an ophthalmologist, our 7-month old son, Harris, and our two Rhodesian Ridgebacks, Rigby and Agate. I am a radiologist in Birlingame." . . . **Lindsay Weaver** is "vice-president of engineering at Qualcom, Inc., a growing San Diego company in Satellite communications technology. . . . Two daughters, 4 and 6 years old. [I] like to hike and do mountain bike rides regularly."

David August writes: "[Being a] surgical oncologist at Yale keeps me running. I'm quite busy clinically and struggle for time to spend in the laboratory. I'm looking forward to going to Talbot House around New Years again this year with a crew of former Burton Third Bombers, Burton House residents, and associates." . . . From **Peter Kaufman**: "This past spring I married Marie Lurquin, whom I met during my fellowship in Philadelphia. As we settle in Winston-Salem, we are preparing for a major upheaval. We are expecting a child in March. I am continuing my research in gastrointestinal motility at Bowman Grey School of Medicine." . . . **James Narrod**, M.D., "recently became director of cardiothoracic transplantation, AMI-St. Lukes Hospital, Denver." . . . **George St. George** has "been promoted from senior research chemist at Dow to project leader."

A march I wrote, 'Helmet of Salvation,' was performed in November by the Brazosport (Tex.) Community Band. . . . **Stephen McConnell** writes that "after five years of service on a 'short term' basis, I'm applying for career membership with Wycliffe Bible Translators. My most recent project was finishing a computer program for morphological parsing. This program has been tested on languages from Peru, Colombia, and the Philippines."

From **Larry Appleman**: "Several of our classmates and other MIT alumni attended the wedding in November of **David Abrams** to **Annekathryn Goodman**. Best man was **Larry Appleman**. **Brian Bradley** was there (he started in our class and is now back as an undergrad at the 'Tute). Other guests were **Betsy** and **Alan Carr-Jones**, '74, **Juniper Russell** '74, **Brough Turner**, '71, **Ellen** and **Reed Sturtevant**, '78, **Susan** and **Steve Simonoff**, '79, and **Michelle** and **Jack Shoemaker**, '82."

Your secretary had a phone conversation with **Rich Lopiccolo**. He spent five years in the U.S. Navy after graduation, until 1982, in the nuclear power program. He then went to Westinghouse, where from 1982 to 1988 he was in the commercial nuclear program. He then switched inside Westinghouse in 1988 to the military nuclear program.

As for your secretary, he remains swamped. The dollar continues in its uneasy gyrations. Coffee, cocoa, and sugar have all provided gut-wrenching moments, sometimes all simultaneously. Crude oil has had its panics as well. We do not lack for volatility in this nervous, jumpy world. On the less nerve wracking side, we moved into our new home in Woodmere with a minimum, albeit not absence, of headaches. **Carp** Voiceways, my brother's and my venture in PC-based voice recognition technology (circuit-board, software, and microphone) has begun to move forward as the world, hungry for a way to input and control a PC by other than the traditional keyboard, begins to nibble. The tempo of my business affairs, always quick, has picked up further. Please continue to write and/or call. We need news.—**Arthur J. Carp**, Secretary, Stalco Futures, Inc., 254 West 35th St., 16th Floor, New York, NY 10001, (212) 736-1960, Fax: (212) 736-3664

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We start this month with news from our classmates in the medical profession. **Renan Beckman Wills** is an anesthesiologist in private practice in Washington state. She has two children; Emily, almost 3, and Peter, 1. They are enjoying living in the Northwest. . . . **Matthew Sherman** is still working at the Dana Farber Cancer Institute on clinical trials as well as signal transduction of growth factors. He has two daughters ages 4 and 1. . . . **William O'Brien III** is an assistant professor in the UCLA Medical School and is working full-time on research into the mechanism of AIDS virus infection. He reports that he continues to live on the beach in Venice, Calif., and will marry **Paula Morgan** of Cedar Falls, Iowa, this year. . . . **James Torma** has entered the medical world after work in a very different field. He had been at Southwest Research Institute in San Antonio working in the area of robotics and automation as a senior research engineer. Then in August 1987, he quit, changed directions entirely, and became a medical student at the University of Texas in San Antonio. After a little trouble with the first semester subjects, he has successfully completed his first year's courses. James expects to receive his M.D. in 1992. He is married and has three children: 6, 4, and 1.

Steven Field is now working as a product manager in DuPont for KALREZ Perfluoro-elastomer Parts. He had his third child, son Kevin, on October 14, 1988. . . . **Everett Butcher** is pursuing an S.M. in civil engineering in the field of construction management at the University of Illinois. . . . **Douglas Currie, Jr.** has moved

"around the pond" to #356 Winding Pond Rd., in Londonderry, N.H. He is vice-president for engineering at Flavors Technology, Inc. in Amherst, N.H., working on a massively parallel processor for real-time inferencing. . . . **Richard E. Korf** and **Kenneth D. Forbus** have each had an article published in *Exploring Artificial Intelligence: Survey Talks from the National Conferences on Artificial Intelligence*. . . . I would be happy to publish your news; please write.—**Ninamarie Maragioglio**, Secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153

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It is my sad duty to report the October death of **Daniel Lieberman**. While at MIT, I participated in many crew practices under the command of Dan in the Coxswain's seat. He even made it back for our 10th reunion last June, and, with his trademark booming voice, coxed a spirited boat of four old rower-classmates up and down the river. We'll certainly miss Dan's wry sense of humor and his quiet, direct demeanor. Dan's parents ask classmates wishing to make contributions to MIT in his memory to designate their gifts for library books. Be sure to note that the gift is being made in Dan's memory.

This column brings with it a raft of news that classmates sent in with their *Alumni Register* questionnaires last spring/summer, so while it may be a bit dated, it is interesting news of classmates from whom we've not heard before.

Craig Hendrix is at Johns Hopkins University, involved in biologic response modifiers, especially as pertains to AIDS research. Craig lives in Greenbelt, Md., and is also active with church evangelism in his community.

Chester Hayes writes from Ocean, N.J., that he's recently switched from applications engineering to sales at Intel and now has responsibility for the AT&T Bell labs account in New Jersey (no doubt one of Intel's most important). Chet also says, "My real passion remains futures trading, and this consumes most of my spare time. With the huge moves in the grains, this has been a most exciting and prosperous year. I hope to be able to devote even more time to this pursuit in the future."

From the Big Apple, **Elaine Harris** writes, "After graduating from business school, I spent several months traveling around the world. I enjoy the study of foreign cultures and assimilation of new experiences. The marketing research I do for Du Pont is for their apparel group. It's all consumer and retail-oriented, even though Du Pont fibers are an ingredient fairly far back in the chain. I've always been interested in the apparel industry, so this job is ideal; it's a nice way to integrate my technical background, business degree, and my personal interest."

Don Harlan says (probably along with a lot of us) that a lot has changed in ten years. He says that he is very happily married, living in a small town surrounded by Los Angeles, and he is now a management consultant when he didn't even know that the profession existed when he was at MIT. Don also writes, "I've never worked as an engineer, but I use the problem-solving skills and broad technical understanding I gained at MIT on a daily basis. It's very clear in the work I've been doing, especially for the last couple of years in manufacturing logistics, that there is a real need for many more people who can combine technical understanding with interpersonal skills. I hope that MIT is doing more to develop the latter and not just the former."

Paul Haines had moved to New Orleans and is a father to Andrew Paul. . . . **Janet Freeman** writes, "While in Los Angeles, I supported the LA Educational Partner (LAEP) as an industry associate of the +PLUS+ program. This program, originally begun by the Ford Foundation, seeks to provide real-world examples, seminars on current math topics, and collaboration with higher education and industry for LA-area high school math



In an after-the-season conversation at the MIT Enterprise Forum's Cambridge symposium on "Marketing Makes the Difference" late last fall: Beth Marcus, '79, of Arthur D. Little, Inc., with speakers Regis McKenna (center), chairman of the high-tech marketing firm that bears his name, and Jay S. Wurts, '73, chairman and CEO of Symbolics, Inc.

teachers. Now that I'm in Seattle, I'm working with the Ford Foundation to start a collaboration up here. I already have contacted a few organizations and individuals to determine local interest. I'd like to contact other local MIT alums who might be interested. I am especially interested in science/technology demonstrations for the classroom, a LA/SF Exploratorium, but my interests aren't limited to that."

It sounds like **Rich Fagin** is living the fast life deep in the heart of Texas: "I was married in September 1983. I took over marketing chores at ACCO Perforators in December 1987. The company is doing quite well despite the oil industry slump. I am still terrorizing Corpus Christi with the Corvette and still thoroughly enjoy dusting the yuppies in their BMW's at the stop light grand prix. (Takes more than a turbocharger to keep up with a big rat motor!)"

Nancy Everds writes from Montclair, N.J., that she is married to Keith Baer, who, like Nancy, is a veterinarian. Nancy is on the staff of a small animal practice in Montclair.

Fern (Crandall) DeVale is now working on pipe support design and analysis software being used to design the Sizewell B nuclear power station in England. After numerous requests from classmates, Fern also wishes to pass along the address for Balfour Rings, makers of our authentic class rings for those who lost theirs or who didn't buy one when we were in school: Balfour Company, Educational Products Group, 25 County St., Attleboro, MA 02703. Write them for prices, etc. . . .

Roy Colby completed his Ph.D. at the University of Wisconsin, Madison, in August 1987 and then joined the faculty at North Carolina State University in Raleigh, N.C., in the Department of Electrical and Computer Engineering.

Sue Kayton writes, "Since becoming a full-time mommy, I am spending what little free time I have doing various volunteer activities. I teach BASIC programming to students and teachers in our local elementary school. Since I'm fluent in Spanish and my husband is an attorney, I volunteer processing applicants for immigration amnesty and have helped legalize dozens of families." Sue is also actively involved in their homeowners' association.

Bill Kuttner and his wife Christine are homeowners in Charlestown, Mass. Their kids attend Boston public schools. Chris sings in the Tanglewood Chorus and in the Cantata singers, and Bill is active in politics and the Boston

Harbor Associates.

In more recent news sent by classmates, **Jeff Snow** writes, "I am finishing an abdominal surgery fellowship in Erie, Pa., am still single, and will probably be moving to parts unknown by the time this makes print. I'd like to hear from old MacGregorites." (Contact your class secretary for Jeff's address.) . . . **Larry Siegel** writes from San Francisco, "I enjoyed a recent visit to Boston. **Mark 'what-a-guy' Truant** was kind enough to provide a cherry Saab. Too bad about those parking tickets. . . ."

Ken Lesley and **Cathy Osman** are based in Carlsbad, Calif., and now have a small child. Ken writes, "Cathy is at sea, flying for the navy. She hopes to be wearing lieutenant commander sometime this fall if the Congress gets around to doing its job. I am designing oil field drilling equipment for Smith International."

Julie Kozaczka ("I Ain't Got No Hyphen") **Stahlhut** wrote to announce her August 1988 wedding to Rick Stahlhut. The newlyweds honeymooned in Hawaii, attracting sharks while scuba diving and clearing Jacuzzis while talking about medical databases. Julie is finishing a certificate in software engineering at Harvard Extension School where, she says, Brass Rats abound on both sides of the lectern. Julie and Rick are now living in Watertown, Mass.

E-Mail users: Julie has volunteered to put together a directory of classmates on the various national networks such as Internet/ ARPAnet/ Etcetera-net, or CompuServe. She can be reached on the networks as: jstahlhu@hstbme.mit.edu and at CompuServe as: Julie K. Stahlhut 76566,1012. Julie says that she has re-established several old friendships over the Internet. Sounds like a great idea! Julie also has volunteered to be assistant class secretary for Networks (probably a first amongst MIT alumni!), so you can now send your news to her over the network and she'll forward it to your class secretary for inclusion in this column.

It's always fun for your secretary to write this column when there is a lot of interesting news. It's clear that classmates, in addition to their professional pursuits, have many interesting hobbies and volunteer activities like helping immigrants become citizens, racing yuppies in BMWs, or playing the futures markets. Why not tell us about what *your* passions are, what you do with the time that is your own? From time to time in this column, I'll feature hobbies and volunteer pursuits of classmates.

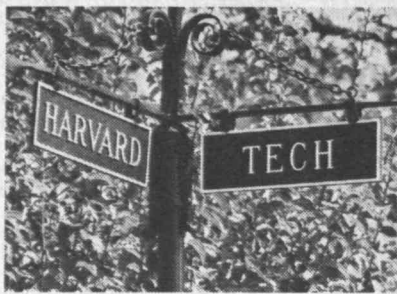
If you write or call with your news, I'll mail you addresses for any lost friends, roommates, or loves from your MIT days (classmates or members of other classes).—**Jim Bidigare**, Secretary, 659 Green St., Cambridge, MA 02139

79

10th Reunion

Well, to make up for the last few months, I got tons of mail recently. So get yourself settled into your most comfortable chair and start reading!

Charles Eliot was in New York on business recently and called to bring me up-to-date. Charles was the recipient of a Rhodes Scholarship, and moved to England following graduation to work for a Ph.D. in biochemistry at Oxford University. He spent three years at Oxford, during which time he also directed and appeared in 28 plays! (You may recall that Charles was an active participant in the MIT Shakespeare Ensemble.) At this point he changed his mind about biochemistry, left Oxford, directed more plays, and became interested in computers. He moved to London and started a company, College Hill Systems, which develops networked data distribution systems for the financial industry. Most of their work has been for the City of London, but the firm has now grown to 26 employees and is expanding its scope of operations (hence the recent trip to New York). Now that he has a client base in the United States, he hopes to attend our reunion in June.



When I was growing up in Pittsburgh, the school bus always went through the nearby community of Thornburg, where the streets were all named for Ivy League schools. It did not occur to me at the time, as I rode down Dartmouth, Cornell, and Yale streets, that this little community would change the world perceptions so completely. For here was the evidence to dispel the most sacredly held belief in academia. There are those who would say, "Harvard is Harvard, and Tech is Tech, and never the twain shall meet," and not without good reason. Nonetheless, the enclosed pictures prove otherwise, taken at the intersection of Harvard Street and Tech Road. . . . To those who might assert that the Tech in the picture actually stands for Carnegie Tech, I can only assert that Thornburg is one of the most respected communities in the Pittsburgh area, and would surely have named the street after the original, accepting no substitutes.—Mark Schafer, '79

Sharon Gardner and husband Tom Jacobs, '75, have a new daughter, Rebecca Margaret Jacobs, born September 16, 1988. The proud parents, along with Rebecca's older brother Will, reside in Salem, Mass. (no excuses for not attending the reunion!). . . . Larry Appleman, '76, dropped me a line to inform me that Susan and Steven Simonoff were among the attendees at the November wedding of David Abrams, '76, and Annekathryn Goodman. Good spy work, Larry. . . . James Thompson, who got his master of architecture from Carnegie-Mellon, has become a senior associate with the architect planning firm of Akers Erwin Gasparella in Pittsburgh.

Tom Berman wrote for the first time since graduation. To quote him, "If you promise to print all of this, I promise not to submit anything for another 10 years." I'm not sure I like that stipulation, but I'll include it all anyway. Tom was married on September 23, 1988, to Lee Ann Burnett (Duke University, '77). Tom's SAE brothers who attended were Hoyt Davidson, Dave Tohir, Bruce Wrobel, Keith Giampontone, Tom Lenk, Al O'Connor, Gary Spletter, Rick Van Etten, '78; Reid Sheftall, '78; Bob Clark, '81; Bill Fowler, '81; Paul Mahoney, '81; Carl Nowiszewski, '81; and Jeff Olson, '81. Dave Tohir and Kathryn Whitehead (Wellesley, '81) were married two weeks earlier. Tom and his new wife honeymooned in New Zealand, then moved into a house in Stamford, Conn., where there is lots of work to be

done but which has plenty of room for guests. On the professional front, Tom is a General Partner with Fairfield Venture Partners in Stamford. He writes, "We have over \$100 million of OPM (Other People's Money) which we use to finance high-tech startups. I'd be happy to talk with anyone who is interested in starting a company or raising cash for a current one." You can write to Tom at home at 139 Pond Rd., Stamford, CT 06902.

Mark McPeak is an assistant director of Foster Parents Plans Office in Tulua, Colombia. They carry out projects benefitting poor families—infrastructure projects such as housing and potable water, as well as human development activities like training and income generation. . . . Daniel Weinreb co-founded a new software company last August called Object Design, Inc. This was Daniel's second computer startup (he also co-founded Symbolics, Inc.). He lives in Arlington, Mass. . . . Carole and Ed Tarney had a son, Brandon Joseph, last November 5. He writes, "Aside from terminal fatigue (and I DON'T mean from sitting at a CRT for too long), everyone is having a great time at home. Looking forward to that station wagon with fake woodgrain paneling, a luggage rack, and ice cream stains all over the seats, along with all the other joys of parenting. Let's see, if he's class of 2010, and we thought \$5350 was TDM. . . ."

Robin and Robert Stall had twin boys last October 28. "They were seven weeks early—I guess they couldn't wait to meet us. 'Double trouble,' you say? 'Better you than me?' Well, we wouldn't want it any other way. I have just completed a fellowship in geriatric medicine—talk about the circle of life!" The Stalls live in Buffalo, N.Y. . . . Another new arrival, this one to Bernita and Brad Myers. Reid, was born last October, joins older brother Ryan, who is 3-years-old. Brad is still a research scientist at Carnegie-Mellon University in Pittsburgh and recently published a book, *Creating User Interfaces by Demonstration*, with Academic Press. . . . Carol Schwartz is in her second year at Harvard Business School, and plans to go into some form of real estate. She and her husband of five years live in Cambridge.

Lawrence Bodony left Kurzweil Music Systems in September to join another Waltham startup, Edsun Labs, as director of silicon development. . . . Jonathan Keefe is still with NYNEX Properties Co. doing real estate work. He is also teaching at night at Boston University, and "partying with the old gang: Dez, Strobe, Palumbo, et al. Saw Fen, Snuffy, and the Wheat in California." (I'm not sure if he's cavorting with the Seven Dwarfs or the kids from the Our Gang comedies!) He also bought a house and 140 acres in Vermont and implores you all to "Come skiing!" . . . Bennett Golub joined Blackstone Financial Management in March of 1988 as a principal. Blackstone is a money management firm specializing in mortgage-related securities. . . . David Westenberg was elected a partner of Hale and Dorr last May. His practice includes securities, venture capital, and general corporate law.

Alix and Panos Cavoulacos had a second daughter, Sophie, last October 11. In November, they moved to Paris, where Panos transferred with McKinsey and Co. . . . Clifford Reid worked in San Francisco for two years after graduation, then returned to Boston to get an M.B.A. from Harvard. In 1983 he returned to San Francisco to work in a small high-tech firm. In 1988 he started a company, Verity, Inc., to develop and sell document management software. . . . Elizabeth Broome is a postdoctoral fellow in molecular genetics at the Wistar Institute, and also holds the title of Hematopathology Fellow at the Hospital of the University of Pennsylvania.

Janet Metsa and husband Michael Mullins (M.S., '80) have moved to Houghton, Mich., about eight miles from where she grew up, on the northern tip of Michigan's upper peninsula. Michael is an associate professor of chemistry and chemical engineering at Michigan Technical University, while Janet hopes to set up her own

environmental consultancy while caring for their two children. She writes, "We are enjoying it here and even the coldest October on record has not daunted us!" . . . Jose Perez is working for Vicky Bondoc, '81, who is running a start-up computer consulting firm in Waltham. Writes Jose, "She was also the Best Man (or should that be Best Person) at my October 15 wedding to Lois De Flumeri (Salem State, '80). After living in a cramped one-bedroom apartment in Cambridge, we bought a house in Medford where we frequently succumb to an intense desire for Toscani's Ice Cream" (I expect to see you both at the reunion.) . . . Deborah (McKechnie) Mossman married Craig Mossman in Iowa City last July 16, after having successfully defended her Ph.D. on July 5. At press time, they were planning a December move to Kansas City, where Deb will be an assistant professor of civil engineering at the University of Missouri. She says that they are looking forward to the reunion, as Craig has never been to Boston.

Matthew Powers is living in Seattle and working for Boeing in advanced systems operations analysis. . . . Kevin Wade writes, "I've lived in North Carolina for two years, and I anticipate moving sometime within the next year. My wife Sheila Luster, '78, and I have decided that we are going to say goodbye to the (U.S.) Air Force in April of 1989. What will I do next? Good question! Ask me at the reunion and with any luck I'll have an answer by then. Our daughter Erika Wade (MIT Class of 2009?) is definitely making some changes in our lives!" . . . Rick Denker has been working in product marketing since receiving his M.B.A. from Dartmouth in June 1985. He recently accepted a position as product marketing manager with Logic Automation in Beaverton, Ore. . . . Dan Jones left the U.S. Army in 1985 and joined MITRE Corp., which recently transferred him to its office in Seoul, Korea. Dan and his wife Mi Kim are enjoying Seoul, and had a chance to see many of the Olympic events, as well as many of the cultural attractions. He is trying to learn Korean, but finds the going slow. At work, he is occupied with the procurement of a command and control system for the combined U.S./Korean forces there. He says, "I'm sure you've seen some of the news about anti-Americanism on the TV. You've probably seen more than I have, in fact. The Koreans that I've met have been very friendly, but of course I haven't gone out of my way to find student protests. I'm hoping to make it back for the reunion, business schedule permitting." . . . Amy Powell lives in Alexandria, Va., but rather than divulge what she is up to, she reports instead on a few recent births. Kate and Ron Parton have a son, Marcus Allen, and Jane and Marcus Julian have a daughter, Alana. Amy, you're a good spy, but do let us know more about your activities (and don't forget to come to the reunion). . . . Bill



Bill Mock

Mock has become director of Worldwide Technical Support for Aspen Technology, located in Cambridge, right on Vassar St. Bill has been with the company since 1984.

Just one more item, then I'll let you go on to reading the other classes' columns. In February, my husband Robert Lustig, '76, and I will perform together in a show for the first time in 13

years. We originally met while doing an MIT Musical Theatre Guild production of *Fiddler on the Roof* in 1976, but have not been on the same stage together since (although we have sung at a couple of weddings, including our own). I have continued to be active in the theatre, and since our marriage in 1984, I have been coercing him to take a break from his research and come to auditions. Well, my nagging finally paid off. We will be appearing in the female version of *The Odd Couple* produced by the Off-Off-Broadway group with which I have been working for the last two years. The down side is that he will be required to shave his beard (although he gets to keep his mustache). I haven't seen his chin for many years. Stay tuned for further reports. And start making those reunion travel plans NOW!—**Sharon Lowenheim**, Secretary, 500 E. 63 St., Apt. 18B, New York, NY 10021

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Greetings from Pennsylvania! I hope everyone had a good, not-too-chilly winter. The class mailbox was reasonably full this month, so here goes.

Errol Antziz writes that he works for the Bank of New York as a corporate lending officer in the communications and entertainment division. He lives in New York City and is a musician by night. . . . **Ralph Vinciguerra** works at Itek Optical Systems in Lexington (Mass.) in Image Sciences and says he's having fun. He recently celebrated his graduation with a trip to Disney World with Lori. His next vacation plans are Montreal and Mardi Gras. "World class partying is the goal!" . . . **David Dubbin** writes that he's been busy since graduation: married Susan Hockey (Wellesley '81), had son Gregory (now 18 months), and earned his master's degree at Sloan. He went to work for Codex in the Boston area after finishing at Sloan, but has recently been transferred to Motorola's Paging Division in Boynton Beach, Fla. His new title is manufacturing operations controller.

Marnin Merrick completed an internal medicine residency at New York Hospital-Cornell Medical Center and moved to Philadelphia last July to start a fellowship in hematology-oncology at the hospital of the University of Pennsylvania. . . . Meanwhile, out in the Midwest **Carol Julin** is working in a renal biochemistry lab and generally enjoying life in Madison, Wisc. She does plenty of cycling and volleyball playing, and sings in the Madison Symphony Chorus. . . . Also in the Midwest, **Tim Morgenthaler** writes that he has completed his U.S. Navy obligation and returned to residency training (in internal medicine) at the Mayo Clinic in Rochester, Minn. On August 17, 1988, he became the proud father of a second daughter, Kelsey Kate. . . . Yet another mid-westerner, **Susan Weil Bates**, is living in northern Minnesota where her husband is pastor for two Lutheran churches. She is in the ambulance service and is involved in church and community groups. At the time she wrote, Susan and her husband were expecting a baby in January. No updates yet. . . . **Tim McManus** and friend have purchased a house on Lake Calhoun in Minneapolis. Tim is still working as a computer consultant.

Cliff McFarland is now an associate in the Environmental Department at the Los Angeles law firm of McClintock, Kirwan, Benshoof, Rochefort & Weston. He graduated from Columbia Law School last May and subsequently took (and passed) the California Bar Exam and travelled in Europe. . . . **Alex Crichton** also lives in California, where he works for Pacific Gas & Electric Co. He's been there almost since our graduation in 1980. He married Ann Barta (Simmons '80) in 1984. They have a home in Palo Alto and enjoy the California weather and the good, outdoor life. . . . **Michael Waxer** and wife Debora (Luehrs), '77, are enjoying life on the Monterey Peninsula and their children: Zachary, 2, and Kira, who was born October 11, 1988. Michael is working

with a design-build contracting firm in Carmel, and Debora returned to work half-time in January as an environmental engineer with the Naval Post-Graduate School in Monterey.

Richard Chin writes that he is still living in Silicon Valley, where he's been with Hewlett-Packard since his VI-A days. He and wife Lily Lock (Wellesley '81) had their first child, Andrea, in May of last year. Last August he attended the wedding of **Mickey Lee** to Carolyn Fong. He and **Kevin Wallace** were in the wedding party. Other MIT graduates present were **Chris Cole**, **Louis Nagode** and **Steve Trapp**, '79. In September, he and Mickey Lee were in the wedding party of Kevin Wallace (who married Susana Lam). **Chris Cole**, **Michael Greenwald**, **Jeff Thomas**, **Jim Banks**, '76, and **J.C. Meroier**, '82, all attended Kevin's wedding. . . . Other wedding news: **Jack Shoemaker** and his wife Michelle were guests in December at the wedding of David Abrams, '76, to **Annekathryn Goodman**. Several other MIT alumni were in attendance. . . . **Joan Solomon** wrote that she married **James Isaac Griffin IV** (Dartmouth College, Columbia Business School) on October 10. **Jennifer Hance**, '83, was the bridesmaid. Professionally, Joan is a vice-president at First Chicago (in New York City), where she lends millions of dollars to communications and entertainment companies. In her spare time, she is still active in an Off-Broadway theatre group. . . . Also recently married (last August) was **Eric Beckman** to the former **Joanne Hodgman Newton**. They were married in Amherst, Mass., where apparently their desire to hold their reception on the Common caused quite a stir in the community. The couple now lives in Washington (state) where Eric works for Battelle Laboratories as a post-doctoral research scientist. . . . My own wedding (October 8, to Geoff Wall, Sloan '88) went quite smoothly and we were very happy to be joined by classmates **Tim McManus** and **Pat Latterell**, as well as several other MIT graduates from various years. As I mentioned in a previous column, Geoff and I have moved to the Princeton, N.J., area where we are both working for E.R. Squibb and Sons.

Dorian Jankowski has joined a group practice in pediatrics in Salt Lake City. She says that "it's very satisfying to be self-employed in a career in which I've strived so hard to achieve and enjoy so much day to day." She does not plan to leave Utah—ever! "Utah offers the most gorgeous, solitary canyon country in America." How's that for advertising? . . . My old Student Center Committee compatriot, **Marlon Weiss**, recently moved to Kansas. He has "one and a half kids," a dog and a new house, and is working as a family doctor. He's now awaiting the time he can use more high technology in his field. . . . After unwinding on a farm in West Virginia after six years in Silicon Valley, **Thomas Zimmerman** is working in New York City as a consultant in electronics and computers. He'll soon be returning to his basement to work on inventions in the consumer electronics field. . . . **Martin Prince** (M.D./Ph.D.) writes that he invented a new method of opening blocked arteries by using laser radiation which is selectively absorbed by arterial plaque. He and his colleagues expect to start clinical trials at the Massachusetts General Hospital. . . . **John Mugeridge** writes that he recently married **Karen Swan** (Simmons 1980) and moved to Waltham, Mass. He wonders if anyone knows the whereabouts of classmates **Clay Struve** and **Steve Petinato**. Any ideas anyone? . . . **Charlie Hoffman** and wife Linda, '82, had their second child, Alexander Louis, on June 2, 1988. His big brother, **Richard Lepnis**, is now 2.

In the political world, classmate **Mike Johnson** is a 1989 candidate for Mayor of Salem, Mass. Best of luck, Mike! Keep us informed. . . . I also received a press release informing me that **Allan Frydenlund** has joined Charles River Associates in Boston as a senior associate in the Technology Assessment Program. Allan has a S.M. in mechanical engineering (as well as his S.B.) and an M.B.A. from the University of Chicago. He

previously worked for Booz Allen, Hewlett Packard, and W.R. Grace. . . . I was also happy to receive a Christmas letter from Mike, '79, and **Diane Patrick**. Son Sean Kevin, born in June, is still thriving and Mike is still director of engineering for encryption products at Cryptall, L.P. in Cranston, R.I. Meanwhile, Diane has set up her own private internal medicine practice, which was just about full after only nine months. She is the only woman doctor in primary care internal medicine in the city of Fall River.

Thanks to everyone who wrote this month. Looking forward to more interesting news next month. Please note my new address.—**Kate Mulroney**, Secretary, 118 Riverview Ave., Washington Crossing, PA 18977

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Ronald Tyler writes to say that he is completing law school at UC Berkeley. Next year he will clerk for a federal judge in San Francisco. He is married to Suzanne Frick. . . . **Benjamin Kermin** is also married and has a 1-year-old adopted son. He is now chief medical resident at Mt. Auburn Hospital in Cambridge, Mass. . . . **Martin Forrester** and his wife, Cathy, had their second child, Timothy, who was born in July. Their older daughter, Andrea, is four. Martin says that she is a real charmer and is already starting to turn the heads of boys!

Joel Garcia says hello from Enfield, Conn., where he is still working for Hamilton Standard. He has seen **David Meyers** and **Tom DeBoissiere**, who both live in Columbia, Md. David's son, Andrew, is nearing his second birthday. . . . **Don Jones** says that he is learning about sales, marketing, and cash flow as a business development manager at GPA Technical Consultants, Inc. He is also studying part-time for his master's degree in industrial engineering. Don and his wife, Ruth, play soccer and run to keep from "stiffening up" before their time.

Dean Daniels completed the Ph.D. program in computer science at Carnegie Mellon in October 1988. Now he is at the IBM Almaden Research Center and living in Los Gatos. . . . **Richard H. Scheurmann** is living in Switzerland and working as a research scientist at the Basel Institute for Immunology. . . . **Barbara Messenger-Rapport** and her husband Kenneth have a son, Nathan, born November 8, 1988 (Election Day). He weighed 7 lbs., 13 oz. and was 20 inches long. Congratulations and best wishes for a good night's rest!

Ephraim Fuchs writes to say that he finished his residency in internal medicine at the Johns Hopkins Hospital in July 1988. He is now at the National Institute of Health in Bethesda, Md., doing research in cellular immunology with **Ronald Schwartz**. He is also "moonlighting" at several hospitals in the D.C. area. In September, he completed his first mini-triathlon (1-mile swim, 6.2-mile run, 25-mile bike) in what he considers to be an abysmal 2:49:54. He claims to have nudged Oprah Winfrey at the finish line. I'm sure most of us, including Oprah, would still be in the water at 2:49:54!

Cliff Schieck writes after noticing that the October issue was a bit short. He is living in an apartment in Munich near the opera house and working for a California electronics company that has a branch sales office in Germany. He expects to be there for another year. He travels throughout Europe on business and enjoys spending many weekends trekking in the Alps. Cliff wishes to say hello to Jim, Nick, and Steve, three of his best colleges friends, and urges them to write. . . . **Paul Marshall** has left the urbane New York City life for pastoral New England where he settled in the Berkshires and manages a residential real estate development project.

Mark Neimer finished his medical residency at Hernepin County Hospital in Minneapolis and re-enlisted for two more years of school as a rheumatology fellow. He says he thinks this will

be his last trip around the ivory tower. Mark and his wife, Yasu, enjoy living in Minneapolis. She is finishing her psychiatry training this year and will start a "real job" in July. They also recently purchased a home. Mark says that school loans are nothing compared to mortgage payments! . . . **Bill Topazio** reports that "Long Island Gold Coast fugitive has surfaced in Brooklyn." Bill is married with 0.00 kids and is still plugging away at film/video biz. He says that he and his wife, Lynn, are okay and that you can find him in New York City at Editle on 44th Street. He suggests that this may be the year he'll finally get a PC and give CP/M a rest.

Charles and Irene Goldberg Dale write to say that they have just returned to civilization from the untamed wilderness of Ohio,—just in time to find that they were being nuked by the Fernald nuclear weapons plant for six years. They are very happy to be back in Boston. Irene is working for Inscribe, Inc., a small company in Cambridge, while Charles is at Symbolics. . . . **Charles (a.k.a. Chuck) Markham** is still with Bain & Co. in Boston where he reports to have finally bought himself a condo and other grown-up stuff. . . . **Randy Cook** is at the U.S. Naval Air Station in Bermuda and is talking to interested high school students about MIT. . . . **George Lesieutre** recently completed the Seattle-to-Portland double-century bicycle race. He also has applied for a patent on high-damping graphite fiber at SPARTA, Inc. In addition, he and his wife Anne are expecting a new addition, their second child in March.

Scott Chandler has been at Pratt and Whitney in Connecticut for two years after a six-year stint in the Marine Corps. He is currently working on an M.B.A. . . . **Richard Park** is at Pugh-Roberts in Cambridge, Mass. He and his wife, Evie, just celebrated their son Benjamin's first birthday. . . . **Amy Davidson**, '82, told me that **Paul Gault** is in his second year of the M.B.A. program at Harvard Business School and that child number two is due any day. Please send details!

Life is finally returning to normal at my house. Our son Eric is four months old now and becomes more fun and playful everyday. Thanks for writing everybody. Please keep those cards and letters coming. Also, if anyone would like to do a guest column, please let me know.—**Lynn Radlauer Lubell**, Secretary, 216 Beacon St., Boston, MA 02116

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The mailbag contained an odd coincidence: two reports from classmates who work under water: **Douglas Stevens** is doing medical research in diving medicine. He recently returned from deployment with the U.S. Navy in the Persian Gulf, where he was diving medical officer. . . .

Michael Collins is currently doing underwater acoustics research at the Naval Ocean R&D Activity Bay in St. Louis. He married Kim Ellen Howard in December 1987 and received his Ph.D. in applied math from Northwestern University last June.

It's always nice to hear about the next generation of Tech alums. **Ricardo Garcia** is working for AVX Ceramics in Myrtle Beach, S.C. He and his wife Karen of nine years (a class record?) have two children—Julia and Kyle. . . . **Linda Hoffman** and her husband Charles ('80) recently had their second son, Alexander Louis. He joins his 2-year-old brother Richard Lepnis. . . . **Thomas Wendel** and wife Donna have three children. Thomas and Donna have joined Wycliffe Bible Translators and, when they finish training, hope to move the whole family to Indonesia to do linguistic analysis and translation work.

Gregory Berube and wife Sarah bought a house in Bloombury, N.J. He is operations manager of silver and copper products at Degussa-Metz Metallurgical. . . . Also checking in from New Jersey (near Princeton) is **Michael Isnardi**, who married Catherine Spano, R.N. last

November. They spent their honeymoon in Antigua, Key West, West Palm Beach, and Disney World/Epcot.

Another newlywed is **Bob Powell**, who has been really busy lately. In rough chronological sequence he: met Judy Marcet while working at LISP Machine, Inc.; bought a house in Cambridge with her; quit his job to do contract software full time; married Judy; sold the house in Cambridge and "bought a nice big house with four acres and two dogs in Windham, N.H., and lived happily ever." . . . Speaking of weddings, **Jack Shoemaker** and wife Michelle were spotted last November at the wedding of David Abrams, '76, and Anne Kathryn Goodman.

Judith Badner reports that she's nearing the end of her career as a perennial student, being in the middle of her third year of medical school. Now she's "trying to decide what I want to be if and when I grow up." . . . It sounds like **Rich Kosowsky** and **Don Gottfried** still have some growing up to do. Rich went to Boston last October to participate in Don's Limo Race Party for Halloween. Rich is working for QUALCOMM, Inc., an up-and-coming satellite communications company in San Diego. Over limo racing he favors beach volleyball.

David Wilson, a lieutenant in the U.S. Navy, is looking to transfer back to San Diego in the fall so he can start flying off of carriers again. His current assignment is an exchange tour to the NATO AWACS base in Geilenkirchen, West Germany, where he is flying in E-3A Sentry planes with multinational crews.

This month's long-distance award goes to **Edmond Ho**, who is working as an environmental protection officer for the government of Hong Kong. He works on issues of water quality, strategic reclamation of land, urban development, and sewage disposal. "Computer modeling," Edmond reports, "is again a part of everyday life."

Drop a line anytime to East Coast Correspondent **Linda Schaffir** (18 Prospect Ave., Apt. B-2, Norwalk, CT 06850), West Coast correspondent **Michelle Gabriel** (656 S. Fair Oaks Ave., D-211, Sunnyvale, CA 44086) or me.—**Stephanie Pollack**, 722 W. Rosco St., #204, Chicago, IL 60657

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We've got lots of news from classmates this month who took the time to tell us what they are doing while giving money to MIT. **Ivan Fong** leads us off from Washington, D.C. Last year, he and his wife had their first child Kelley Christine. The three of them spent the year in London, where Ivan studied for a B.C.L. degree at Oxford while on a Fulbright scholarship. This year, Ivan is clerking for Judge Mikva on the U.S. Court of Appeals for the D.C. circuit. Next year, he will be clerking for Justice O'Connor on the U.S. Supreme Court.

Ron Bianchi writes from Carnegie Mellon in Pittsburgh, where he will be finishing his Ph.D. in electrical engineering in December 1988. Ron has already accepted a tenure track faculty position in the Electrical Engineering and Computer Engineering Department at Carnegie Mellon, and he will start work in January 1989.

James Miller, Jr. writes that 38 months of touring the Orient on the U.S.S. *Midway* is enough. He is now back in Conus, teaching the students to fly the best A&W plane in the world, the E-2C Hawkeye. James says that the beach agrees with him, and that he is slowly regaining his rugby skills. . . . **Marcello DiMare** writes from Cambridge. He received his Ph.D. in chemistry from Harvard this past June, and has returned to MIT for postdoctoral work with Professor Richard R. Schrock in the Chemistry Department.

Effie Nestorides writes that she has decided to move back to Athens, Greece, for good. She is working for the Athens Water Co., and is presently fixing up the house she is living in. More importantly, Effie notes that she is engaged to "a great Greek computer whiz" and will get

married this spring. Effie says that her life is just Ouzo, sun, and dancing all night. Tough life Effie!

Kim Phuong Nguyen Clinton writes that she married Lehigh graduate Michael Clinton, and they have a baby boy named Timothy. Kim works for IBM in Burlington, Vt., as the IBM assignee to SEMATECH (the U.S. consortium of 14 semiconductor companies). Kim and family will be moving to Austin, Tex., for the next two years, and then they plan to return to Burlington.

Carroll Dodson is now Carroll Dodson Williams. She married Stephen Williams on July 16, 1988. The newlyweds both work for Atlantic Research Corp. and are living in Manassas, Va. . . . **Lillian Ruston** received her Ph.D. in electrical engineering in May 1988. She currently lives in Manhattan, and commutes to Bell Communications Research in New Jersey. . . . **Bert Ashbrook** writes that he returned this past summer from Transylvania, where he was part of a joint Romanian-American caving expedition. He is currently living in Allentown, Pa. . . . **David Cooke** is currently a second-year resident in pediatrics at the Johns Hopkins Hospital in Baltimore, Md.

Lawrence J. Dunn writes from Fort Worth, Tex., where he says he is enjoying the fresh air. . . .

John M. Lambie writes that he is a senior hydrogeologist at Levine-Fricke, in Emeryville, Calif. . . .

Barry Margolin is still active selling tickets to LSC movies, and also can be found with the MIT bridge club. He is currently living in Arlington, Mass.

Michele Devereaux writes that she married Pierre Gaudreault on October 1, 1988. They honeymooned on a cruise to the Bahamas. At the wedding were fellow '83ers **Monica Alcabín** (who was the maid of honor), **Jim Holderle**, **Mark Contreras** and **Tom Pollard**. Michele was also accepted into the Ph.D. program at the Air Force Institute of Technology at Wright-Patterson Air Force Base in Ohio.

Lastly, I just received a Christmas card from **Jeff Muss**, **Jeff, Mike Santullo**, and **Kinta Foss** had the time of their lives on a recent trip to Jamaica. Word has it that they are each considering giving up their current careers to return to the island to become rice moguls. That's all for now folks. Keep those cards and letters coming.—**Jonathan Goldstein**, Secretary, 2 Soldiers Field Park, #201, Boston, MA 02163

84

5th Reunion

Dear Classmates, Hope everyone had a good holiday! All I can say is that I am getting older—our fifth-year reunion is just around the corner! And now, onto the news. First I would like to congratulate a few more friends on their impending marriages. **Eric Backus** will be getting married this spring in Seattle and **Terry Tatad** and **Hal Kennel** will be getting married around Christmas time.

I received a letter from **Andrew Chien** who is still working on his Ph.D. at MIT, who writes about a few of his Phi Sigs (and of course puts a disclaimer on where the information comes from!) . . . **John Lim** is working for Hoffman Laroche in New Jersey and "cruising the night life in NYC." . . . **Jeff Goodman** "has left Teradyne and is working in Japan . . . seems to be doing a culture/language immersion thing." . . . **Paul Walsh** is working in Boston for New England Biolabs and living in Belmont. . . . **Chun-Tsao Huang** is still working in Japan. . . . **Mike Wilt** is married, settled down and working for a robotics/vision company called Automatix, and also a father of two kids. . . . **Don Gillies** has returned to Illinois and is studying for a Ph.D. at the University of Illinois. . . . **Kihyun Kim** recently married Marisa McGettigan and is still working at Goodyear in Akron. . . . **Ken Traub** just received a Ph.D. from MIT in computer science and is "considering his options."

Now onto more news from the alumni office. **Laura Bagnall** is finishing her master's in com-

puter science at MIT. . . . **John Abrams** recently celebrated "the completion of loft construction in our Cambridge condo." . . . **Erik Gilbert** writes that he is "currently living with Bob Reinhold in the D.C. area. I see a lot of MIT grads all the time at work and socially. My company recently was bought by Ernst & Whitney—after years of working in high tech, I now have to learn how to deal with accountants." . . . **Richard Lucas** writes that he "graduated from UCLA with M.S. in aerospace engineering in June 1988. Just founded an Amiga computer user's group at UCLA." . . . **Audrey Dow** "moved back to civilization and working at DEC in Northboro, Mass." (Welcome back!) . . . **F. Yan Liu** is now "a second year associate at Boston law firm Mintz Levin Cohn Ferris Glovsky & Popeo, P.C.—practising in the corporate law section." . . . **Maria Paget** is "finishing up a master's in technology and policy here at MIT. Will be moving back to France with my fiancé, Philippe Bosquet, in June." . . . **Julia Goddard Weatherby** "married Gerard Weatherby, '82, in 1984. Daughter, Kathryn, was born March 1988. Working at Luchini and Milfort Engineering in Wethersfield, Conn., consulting for architects and working on cogeneration projects."

Doris Karlson quit her job at Imagen in Santa Clara to return to grad school. "I'm now studying computer science at University of California, Berkeley." . . . **Elaine Lee** is "happily working at Boston Scientific in Watertown, Mass., as the project leader for the development of a new angioplasty catheter. I still hang out at MIT about twice a week with the Ballroom Dance Club." . . . **Nancy Defeo** is working at TASC in Reading, Mass., and is glad to be back in the Boston area. . . . **Jorge Diez** is currently in his third year of medical school at University of Puerto Rico. . . . **Ted Fischer** writes: "Foster-Miller, Inc. 1986; married May 1987; three stepchildren; one college freshman at University of Rhode Island, one high school senior, one 13-year-old; life is good!" . . . **Bruce Kinzinger** is graduating from University of Kentucky medical school in May 1989. He will be getting married to Baher Unesadeh, and starting his family practice residency training. . . . **Will Gaherty** is "currently middle management in a medium-sized environmental consulting firm in Vancouver, B.C., and enjoying the skiing and sailing." . . . **Charles Oppenheimer** is working on his Ph.D. in mechanical engineering at MIT studying machine noise. . . . **Richard Feldman** has "just been promoted to director of new media research at NBC" and works in all sorts of "high-tech projects like high definition TV and cable TV." He and his wife Annette live in Teaneck, N.J. . . . **John Adams** works "at the Johnson Space Center, developing robots for the space station. I'm also doing some scuba diving in the Gulf. How about a class of '84 ski trip this year, any takers?" Keep writing!—**Mona Wan**, Secretary, 12231 Viewoak Dr., Saratoga, CA 95070

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Erik Devereux was admitted to candidacy for a Ph.D. in government at the University of Texas at Austin. He is preparing to do research on the press and politics during the Vietnam war. He is looking forward to visiting MIT for the upcoming Experimental Study Group reunion. . . . After three years in graduate school in the Chemistry Department at Yale, **John Ragan's** research advisor accepted a position in the Chemistry Department at Harvard. His research group moved with him, so John is now back in the Boston area. He also plays in the Harvard Jazz Band. Nowhere near the MIT Festival Jazz Band, he says, but still enjoyable. . . . **Paul Laibinis** is in chemistry graduate school at Harvard, doing surface chemistry research. He has a position as a resident tutor at Lowell House. . . . **Chen-Nip Lee** received the Alfred P. Sloan dissertation fellowship in math for the 1988-89 academic year.

Marion Evatt will receive her M.D. from Emory University in May, after which she will do an in-

ternal medicine internship followed by residency training in neurology. She saw **Sarah Keagle Cooke** and Dr. Dave Cooke, '83, in Baltimore while doing a visiting elective at Johns Hopkins. . . . **Elizabeth Raphael** is a senior medical student at Wayne State University in Detroit where she's had a great time and has met some alumni. Elizabeth is applying for residency positions in emergency medicine in the Midwest and East Coast.

Jeffrey Chang received his MSEE from the University of California at Los Angeles in September 1987. He is now at the Flight Computer Section of the Jet Propulsion lab in Pasadena, Calif. . . . **Ed Korczynski** is working as a process development engineer for SenSym, a smallish semiconductor manufacturer in Sunnyvale, Calif. He is living in the Santa Cruz mountains, commuting in a sports car or on a motorcycle. Most of his free time is spent practicing meditations or saxophone, or with his girlfriend. He has this advice: "Create your own reality. If you don't, who will?"

Irina Rakin (she did not change her name to Pietrzak when she married) is senior engineer with Baxtor Healthcare (formerly Baxtor Travenol) in new product development. . . . **Carl Pietrzak** and **Irina** just signed a contract on their first house. It will be custom built by this summer in part of a new development. . . . **Steve Meszaros** has also recently become a homeowner. He is also a "slumlord." Last July he purchased a huge, turn-of-the-century house in Sandusky, Ohio, which has been converted to a triplex. When he is not spending all his time in Michigan hotel rooms on temporary assignment to Ford Plastic Product Division headquarters, he is involved in the slow process of renovation. It should keep him busy for a couple of years! He is getting used to 11-foot ceilings, fireplaces, and french doors after two years in your basic "econobox" apartment.

Celia Lee is currently working for a small testing laboratory in Concord, Mass., the Advanced Materials Laboratory. She took a year off after earning her S.M. in mechanical engineering at MIT in '87 and is now readjusting to a technical environment. . . . **Andre DeSimone** also took some time off. He spent two years with the Peace Corps in Africa. He is now working for Smith Barney in the Corporate Finance Division. He is in the Mergers and Acquisitions Group.

Michael Davon has a new job as a consultant in Japan for nine months. . . . **Alan Williams** is still going strong in Rome, N.Y., with the U.S. Air Force. He started his fourth ski season with new skis and a ski pass. He saw **Lyle E. Tripp II** at a wedding at the end of October when eight inches of snow fell. He got out of SDI work and is now spending money on tactical computers. . . . **Jose Cordeiro** spent last summer working in the Center for Strategic and International Studies in Washington, D.C., and taking courses in economics at Georgetown University. He is now back in Africa (this time in Algeria) working in oil exploration for Schlumberger.

Phyllis Chun has been working at Morgan Stanley for the past three years. She wants to get in touch with **Mike Supina**. So, if anyone can help please give me a call and I will put you in touch with her.

Geoffrey Wong is starting a company in Singapore with John Koeneman, '85, doing fund management. He received his S.M. in management from Sloan. . . . **Atul Jain** founded Tech Hackers Inc. over two years ago. Niels Lauritzen, '84, has joined the firm which moved to Manhattan. Atul says that any friends visiting New York should drop by.—**Stephanie Winner** (Internet: winner@apple.COM), Secretary, 1026 Live Oak Dr., Santa Clara, CA 95051, (408) 985-6827

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Jerry Martin writes from Cambridge, Mass., where he is working for his Ph.D. in nuclear en-

Storch Engineers

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Surveyors	
Planners	Jericho, NY
Geologists	516-338-4500
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Landscape Architects	617-783-0404
Environmental Consultants	Providence, RI
	401-751-2235
Florham Park, NJ	Washington, DC
201-822-2600	202-785-8433
Robbinsville, NJ	
609-259-0640	
Manchester, NH	
603-623-5544	
Wethersfield, CT	
203-529-7727	

gineering. He says that **Dan Harasty** got married to **Susan O'Leary** in Freehold, N.J. Dan and Susan met in Africa; Dan was working with other members of the BaHai Faith in Botswana and Susan was with the Peace Corps in Swaziland. They both work in New Jersey now, Dan with Bellcore and Susan with the state as an environmental engineer. Other PBE's attending the wedding were Alex Cohen, '87; Dan Margolis, '87; Forrest Thiessen, '85 (with his wife and two children); and Roy Steiner, '85. Jerry spent an enjoyable summer at the West German national nuclear research lab of KFA near Cologne. He even managed to exercise his Eurail pass in six different countries.

Other '86ers include **Michael "Ziggy" Blair**, who should have finished his masters in computer science and engineering last term in time to start on his Ph.D. . . . **Mary Manger** got a new name last year. Unfortunately, Jerry doesn't say what it is. Mary is working on her Ph.D. in Course III, doing work in thin-film techniques for high-temperature superconductors. . . . **Bob Henshaw** is at Tufts Medical School. . . . **Jae Kim** finished his master's in electrical science and engineering and headed north to med school in Canada. . . . **Marco Ambrosoli** is at Boston College studying philosophy. . . . **Homero Rey** is doing biology research with Mass. General and starting to think about grad school. . . . **Ed Love** is working at Batelle Northwest Labs in Hanford, Wash.

Kelly Grant married Chris Craven, '84, last August, and after their honeymoon in Hawaii they moved to Belmont, Mass. Kelly works at the Army Materials Technology lab in Watertown, studying adhesive cure chemistry and other polymeric materials. She says, the MTL may be in jeopardy, however, because of the new Pentagon base closing list. In her spare time, Kelly plays rugby for Beantown, a nationally ranked local team. She has also been helping to train new goalies for the MIT women's hockey team, since her demanding schedule forced her to permanently retire from that position. Husband Chris is currently working for the start-up company American Superconductor Corp. in Cambridge. He claims that they're the hope of America. . . . **Angela Lowry** married Otis Bricker two years ago, worked for a small bio-engineering firm for a while, and is currently in grad school at Harvard, studying for a Ph.D. in biology. Angela is living in Somerville. . . . **George Mitsuoko** is also living in the area, in Cambridge. . . . **Caroline Richardson** should be finishing up her two years in the Peace Corps in Lesotho, Africa.

Irina Rakin is a senior engineer with Baxter Healthcare in New Product Development. She married Carl Peitrzak, '85, and they just signed the contract on their first house. They are currently residing in Schaumburg, Ill. . . . **Robert Anello** finished grad school at SUNY, Stony Brook in New York, and is now working in R&D at the New York Eye Surgery Center. . . . **Andrew Marshall** says he is no longer in grad school and spent half of last year tutoring chemistry. He will soon be tutoring full time. Andrew currently resides in Madison, Wis. . . . **Stan Shull** is working for the Center for Space and Advanced Technology in Arlington, Va., as a space and technology policy analyst. He is assisting NASA in developing policies and procedures to enable private-sector investment and involvement in the Space Station program. **Roy Briere** has switched from theoretical to experimental high-energy physics. He works on experiment E773 at Fermilab in Chicago. . . . **Steven Gaiser** just finished his first year at the Jet Propulsion lab in Pasadena, Calif. . . . **Harish Sangani** finished his master's in chemical engineering at Stevens Institute of Technology. He has since been working at Enichem Americas on polymer blends projects. . . . **Stephen Robbins** spent a year working as a trainer after tiring of programming in late 1987. He is thinking of moving into business organization design and corporate training in communication and management skills. . . . **Alberto Moel Modiano** is working on his Ph.D. in Course VI.

Edward Martin is living in Manhattan and working at Factset Data Systems. . . . **Rob Rozier** is a lieutenant JG in the U.S. Navy. He is serving as assistant overhaul coordinator for USS *Okinawa*, currently undergoing a nine-month, \$30 million upkeep. After leaving the Navy in early 1990, he hopes to return to MIT to pursue a master's in nuclear engineering. . . . **Linda Robeck**, after completing one year at the Jet Propulsion Lab's Guidance & Control Section, was given her own small project, with supervision of five engineers. This project will put a High Resolution Imaging Spectrometer (HIRIS) into polar Earth orbit aboard the EOS (Earth Observation System) platform in 1995 or 1996. . . . **Jaime Guillen** works for the Nuclear Regulatory Commission in Washington, D.C., reviewing daily operational events at domestic nuclear-power reactors and issuing safety bulletins and information notices to alert the nuclear industry to safety problems.

Steward Clamen is in the computer science Ph.D. program at Carnegie Mellon. He expects to graduate before the "turn of the century." He became an educational counselor in hopes of encouraging aspiring scientists to attend MIT over CMU. . . . **Sara Woodhill** married Craig Fuget, '83, in July 1986. She received her master's in materials science from Stanford in December 1988. . . . **Daniel Kulp** spent nine weeks last summer working for ICI in Runcorn, England. He will return to England this spring to do research at a university in Manchester, and will study structure modeling of the new oxide superconductors. He can't "wait to get his hands on a pint of bitter." . . . **Ed Podszus** took time off from his job (three years, that is) at General Motors to attend law school at the University of Michigan in Ann Arbor. He says that Ann Arbor is a nice little city if only he had more time to enjoy it. . . . **Caroline Wang** is attending grad school in the Bioengineering Department at UC San Diego. She is studying knee ligament mechanics. She hopes to graduate in June 1989 with her master's.

Noel Zamot finished electronic warfare school and flight school last February and follow-on U.S. Air Force training in July. He also went through survival training and is now flying at Griffiss AFB in N.Y. He sees **Rich Maurer** quite often and has visited **Marilyn Oberhardt** and **Carl Resnik** in Boston. Noel says "Tell **Heather Irving** to write!" . . . **Derek Barkey** is working on his master's in aerospace engineering at USC. He is doing materials research for the National Aerospace Plane at Douglas Aircraft Co. . . . **Nicos**

Anastasopoulos is in his third year in New York. He left Booz-Allen a year ago for Baring Brothers, an English investment bank.

Finally, I became engaged to a fellow Air Force lieutenant, a graduate of Stanford. We plan to marry this November. Thanks for the info.—**Mary E. Cox**, Secretary, 1800 Hermosa Ave., #A, Hermosa Beach, CA 90254

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My first column in 1989. . . **Rod Moreno** and **Felix Partow** had an amazing party in their apartment in Brooklyn, N.Y., to bring in the new year. Lots of old school friends were there: **Steve Cooperman**, **Jim Bernabeo** and his wife, **Bob Frank**, **Rob Hubal** and his wife **Elaine Cohen**, **Steve Mackler**, **Buzz Moshetti**, '86, **Andy Bain**, **Jeff Khlor**, T. J. Craddick '88, **Janet Zahradnik** and **Mike Foley**, **Maria Kozloski** and **Drew, Jon Gruber**, **Rick Smith**, **Ken Kharbanda**, **Gene Cohen** and **Andrea**, and **Dave Chen**. The night before I also saw **Dave Napoli** (top of his class at Downstate Medical School) and **Melanie**, **Andy Plump** (UCSF), and **Ken Corless**. I've got lots more information to let you in on, too, thanks to all your help.

Steve Berczuk finished a master's in operations research at Stanford last June and moved to Newton, Mass., in October. He is now working for DB View in Waltham as "technical support engineer."

Chinny Yue writes to give an update on "life since being an MIT undergrad." Chinny went to graduate school at MIT in mechanical engineering and got her master's in February 1988. She then started working at AT&T Bell Laboratories, Holmdel, N.J., as a systems engineer in Network Services Planning. She and her husband, **William Shyd**, '85, were married in May 1988 and are living in a townhouse of their own with a "never-ending" mortgage. Chinny sings with the Monmouth Civic Chorus in New Jersey and will be cast as "Rose Maybud," the female lead in "Rudigore" by Gilbert and Sullivan in May 1989. (She also says she misses MIT a lot!)

Geoff Kelsch, one of my top correspondents, writes with lots of information. . . . **Steve Thome** is a Navy helicopter pilot in Pensacola, Fla. Last June, **Tom Zirps** and **Eric Andrews** came out and visited Geoff in San Diego during their cross-country road trip. In July, Geoff saw **Todd Malone** and **Corry Kerstetter** in the Bay area. In August, Geoff saw **Corry, Todd**, and **Mike "Killer" Roberts** in San Diego. In September, Geoff moved to Mississippi to join his ship, the U.S.S. *Princeton*, a new cruiser.

On his way out to Mississippi from San Diego, Geoff spent two days in Austin, Tex., with **Greg Mount** who was then working on a job there with Arthur Anderson. In October, Geoff was in Boston for the Head of the Charles. He stayed with **Killer** and **Tom Hoffman**. (Tom is a manufacturing manager for Proctor and Gamble Manufacturing Co., in Quincy, Mass., and is also the J.V. soccer coach at MIT.) For Thanksgiving, Geoff went on a windjammer barefoot cruise in the Caribbean (West Indies). It was awesome! In February, Geoff's ship will be commissioned and will be transiting through the Panama Canal to Long Beach, Calif., just south of Los Angeles. Geoff will be living there in March.

Dana Takaki is working at KLA Instruments in Santa Clara, Calif. She finished her M.S. in mechanical engineering at Berkeley last summer and is getting married to **Charles Denning** in March 1989. Congratulations!! Others at KLA include: **Andy Weiss**, '85, **Dave Chan**, '82, **John Appgar**, **Luna Ho**, '84, and **Ray Wong**, '84. . . . **Irene Griff** is presently a second-year graduate student in the Biology Department at Princeton University. . . . **Andrew Gerber** is living in Denver with **Todd Ogawa**. . . . **Charles Lewinsohn** passed his candidacy exams at Penn State University and is enrolled as a doctoral student in ceramics science. . . . **Michael Schimpt** and **David**

Esterby have started jet training for the navy in the T-2 Buckeye in Beeville, Tex.

Dominic Leung is attending graduate school at UC, Santa Barbara. He ran into **Amy Austin** at the American Ceramics Society Pacific Coast Conference in San Francisco. . . . **Lorenzo Flores** is a consultant for Ernst and Whinney in a corporate finance group. Outside of work, he has enjoyed being a Big Brother and is active in the Sertoma Club of Atlanta.

Gregory Hammel received his M.S. in manufacturing systems engineering from Stanford last June and is now working for a small biotech laboratory instrument builder in the Bay area. He is enjoying California and living in a six-bedroom house in Los Altos, Calif. with four other MIT grads: **David Sangster**, **Erik Toomre**, '84, **Lain Hueton**, '84, and **Sarah Saltzer**, '84. . . . **David Sangster** also graduated in June from Stanford and is now working for HP.

Ken Fagin is working in St. Louis for McDonnell Douglas in Guidance and Control after 16 months in Strength Engineering. He is actively involved with the Educational Council and the MIT Club of St. Louis. He is working toward a Dive Master Certification and applying to law school. . . . **Jim Loenig** is in his second year of law school at the University of Miami. He will spend the summer in New York working for the law firm of Weil, Gotshal & Manges performing real estate and merger and acquisition legal work. Jim just celebrated his four-year anniversary dating **Christine Miller**, '88 (graduate, MIT Practice School for Chemical Engineering, '89). Christine has spent several months, as part of her master's program, working with Dow Chemical and General Electric.

Thanks for all your help! Enjoy the spring and write me a letter.—**Stephanie Levin**, Secretary, 41 Prentiss St., Cambridge, MA 02140, (617) 547-6673

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Hello everybody, I'm writing this after seven days of Christmas vacation . . . how I miss IAP!! . . . **John Joseph** is currently employed at the MITRE Corp. in Bedford, Mass. . . . **David Anderson** started work last August for McDonnell Douglas Astronautics Co. in Huntington Beach. He has a position on the Space Station Program working on the application of telerobotics to extravehicular activity. . . . **David Brunco** is a first-year graduate student in the field of materials science and engineering at Cornell.

Abdun Ruiz is working in Boston. . . . **Joe Alfano** is a graduate student in mathematics at UCSD. . . . **Joe Simansky** is living and working in Texas for General Dynamics designing airplanes. . . . As for the latest wedding news, **Ginny Loop** married **Bruce Maggs** last July.

Louis Pepe writes about many of our classmates. He is currently working as a graphics software engineering at Penn State University's Center for Academic Computer. While on campus one day, he ran into **Ann Okamura**, who is now a first-year grad student in civil engineering.

Louis spent Veteran's Day weekend in Boston with **Orlee Israeli** and **Melvin Lu**, both first year med students at University of Pennsylvania. At **Cindy Closkey**'s house in Cambridge, they met up with **Stacey Hoffman**, a vet school student at Ohio State University; **David Krakauer**, finishing his V1-A at DEC in the Boston area; **Wilson Hsieh**, now a Course VI Ph.D. student; and **Debbie Lerner**, a Harvard med student. Cindy is a technical writer at a computer company in Cambridge. **Lisa Gassaway** is working at the same DEC branch as David Krakauer.

That's all for now. Since these columns are published about three months after submission, feel free to write about what you think you will be doing in the future, summer plans, etc. You all should have my address by now, so please write!!! Looking forward to hearing from you!—**Grace Ma**, Secretary, 435 East 30th St., New York, NY 10016



COURSE NEWS

I CIVIL ENGINEERING

Maj. Gen. (USA Ret.) **Robert F. Seedlock**, SM '40, writes that he is now the editor of the *Journal of Aerospace Engineering* of the ASCE, and welcomes papers for publication from faculty and students, both graduate and undergraduate. He is also chairman of Sino-American Ventures, Inc., assisting companies to do business in China. . . . **George B. Raymond, Jr.**, SM '82, is currently working toward a doctorate in railroad planning at the Ecole Polytechnique Federale in Lausanne, Switzerland. . . . **Lamberto Andreotti**, SM '77, has been named director of Leeco Diagnostics of Southfield, Mich. Leeco is partially owned by Recordati S.p.A. of Milan, Italy, of which Andreotti was formerly director of corporate development.

Led by **Herbert H. Richardson**, ScD '58, TRB chairman, seven members of the MIT community had major parts in the 1989 annual meeting of the Transportation Research Board in Washington early this year. The participants, in addition to Richardson, who is dean of engineering, Texas A&M University system, were **Daniel Brand**, SM '61, vice-president of Charles River Associates, Boston; **Damian J. Kulash**, PhD '71, executive director of TRB's Strategic Highway Research Program; **Denman K. McNear**, '48, president of the Southern Pacific Transportation Co.; **Robert E. Skinner**, SM '71, manager of TRB's Transportation Research Information Service; **Joseph M. Sussman**, PhD '68, director of the MIT Center for Transportation Studies; and **Louis R. Thompson**, '63, railways advisor at the World Bank.

As manager of technical services for Transamerica Rail Leasing Corp., **Charles T. Daniel**, SM '82, handles maintenance cost control functions and writes engineering specifications for their transportation equipment fleet, which includes more than 40,000 piggyback trailers. . . . After spending 1975 as a research associate at MIT, **Stavros A. Anagnostopoulos**, CE '71, moved to Houston where he worked on offshore structures as a senior research engineer with Shell Development Co. Returning to Greece in 1981 as the first head of the Earthquake Engineering Research Institute in Thessaloniki, he moved in 1986 to South Greece. There he continues in the same field as associate professor of Civil Engineering in Patras, where he lives with his wife and three sons.

James F. Hamel, SM '66, writes that he recently attended the International Symposium on Engineering Geology of Ancient Works, Monuments, and Historical Sites in Athens, Greece, where he presented a paper on "Archeological Investigation of a Monongahela River Terrace," and later inspected dams, archeological sites, and renovations of historic structures in Northern Greece. He runs Hamel Geotechnical Consultants of Monroeville, Penn. . . . **Mark and Diana Pape**, SM '81 and '82, respectively, report that they are kept busy as consultant engineers with two small children, Benjamin and Jennifer. . . . **Edward G. Nawy**, CE '59, was named honorary professor at Nanjing Institute of Technology, People's Republic

of China, in 1987; his textbook, *Pre-stressed Concrete*, was published in January of this year by Prentice-Hall.

Thomas W. Brockenbrough, Sr., SM '46, retired last September from the University of Delaware, and was recently installed as ASCE District 5 director. He was also appointed to the NCEE Committee for civil engineering exams. . . . The ASCE's 1988 Thomas A. Middlebrooks Award was presented to **Demetrios C. Koutsoftas**, CE '72, and two co-authors of a paper deemed worthy of special commendation for its contribution to geotechnical engineering. . . . After retiring from the army as a colonel in 1972, **Edward C. West**, SM '56, served first as president of Green International (1972-76), and then of Edward C. West Associates, Inc. (1976-87). He is now president of Agripost, Inc., maker of fertilizer from municipal solid waste. Its first plant is under contract, financed, and under construction in Dade County, Florida. . . . **Douglas A. Haith**, SM '66, professor of agricultural engineering at Cornell University, has won the ASCE's 1988 Wesley W. Horner Award for a paper he co-wrote on the disposal of sludge from municipal sewage treatment plants.

Albert H. Bryan, Jr., SM '48, a former vice president at Raytheon Co., died on October 25, 1988. No further details are available. . . . **John Turci**, SM '50, died on November 8 in San Jose, Calif. He was a U.S. Navy veteran involved in underwater demolitions, and had received a Silver Star for heroism. Turci was an engineer at Lockheed Aircraft Corp. for 26 years, and was involved in the development of the Glomar Explorer Recovery Vessel; in the Deep Quest Research Submersible he explored the sea to the depth of 3330 feet. . . . **William Atkinson**, SM '79, was killed along with his wife in the explosion aboard Pan Am Flight 103 in Scotland in December. He was employed for 10 years by The Beacon Companies, a Boston real estate developer and builder, where he worked on the construction of One Post Office Square and Rows Wharf. He had recently joined Olympia and York, and had moved to England in March of 1988.

II MECHANICAL ENGINEERING

ASME has conferred honorary membership on **Edward A. Saibel**, PhD '28 (IX), U.S. Army Research Office (retired), of Durham, N.C. His citation read: "for sixty years of outstanding, innovative contributions to engineering education and applied mechanics research and for his dedication to basic research and technical leadership. . . . After partial retirement from the Milton Roy Co., **Erwin G. Loewen**, ScD '52, has become a part-time professor at the Institute of Optics of the University of Rochester. . . . **Roy E. Rayle**, SM '49, writes that he recently did consulting work for Delco Systems Operations of GMC in Goleta, Calif., on the engineering aspects of cannon mounts on C130 Hercules aircraft. . . . **Charles E.B. McConachie**, SM '51, rejoined Canadair, Inc., in Montreal last year as vice-

president for development and marketing of a new 50-seat regional jet, after 21 years as president of a consulting firm, Aviation Planning Services Ltd. . . . **John J. Moskwa**, PhD '88, has accepted a position as assistant professor in the mechanical engineering department at the University of Wisconsin-Madison.

From Jakarta, Indonesia, **Daudy Bahar**, SM '85, reports that after two years as an operations engineer at Marathon Petroleum, he is now general manager of the Noree Indonesia paper factory. . . . **Bharat Bagepalli**, ScD '84, of Schenectady, N.Y., is working at the Corporate R&D Center of GE in the solid mechanics program. He was recently honored for developing MAP, a general-purpose dynamic analysis code. . . . **Mike Connolly**, SM '82, is studying for an MBA at Stanford, Class of '90. . . . **David A. Hablani**, SM '84, is at Arthur D. Little doing contract research in the engineering sciences section's Thermo-Mechanical Systems Unit.

"Like most mammals, I go on four legs," writes **Philippe M. Dumortier**, ScD '52: "My job as president of Braconnot S.A., a major marketer of non-ferrous metals in the French market; the vineyard and winery of Chateau de La Preuille, a famous growth of Muscadet-sur-lie, that I own and operate with my brother; the MIT Club of Paris, where as vice-president I have worked for the last four years to promote the cause of MIT and further the bonds between alumni; and last, but not least, my family, which appears to be 'decreasing' with our first born now a freshman at Princeton."

Serope Kalpakjian, SM '53, was recently elected a Fellow of ASM International. His new textbook, *Manufacturing Engineering and Technology*, was published in March by Addison-Wesley. . . . **Richard M. Lueptow**, ScD '86, has joined the mechanical engineering faculty of Northwestern University. . . . **Ravinder K. Sakhija**, ScD '71, writes that he is president and CEO of Tecogen Inc., a subsidiary of Thermo Electron Corp. Tecogen manufactures and markets packaged cogeneration and gas-fired chiller systems. . . . After serving as subproject manager for the Altitude Control System on the Gamma Ray Observatory at TRW, **Frank Tai**, SM '80, now has joined Microcosm, Inc., in Torrance, Calif., which specializes in spacecraft mission analysis and altitude determination. He is involved in marketing and program development as well as engineering.

Cognition, Inc., the third start-up venture for **Philippe Villers**, SM '60, is seeking a buyer, owing to an inability to raise capital. The firm's chief asset is its Mechanical Advantage software, which allows engineers to instantly change the geometry of their designs by redefining functional requirements. Villers had previously founded Computer-Vison, Inc., and Automatix, Inc. Villers resigned as president of Cognition last fall.

Joseph K. Ting, SM '74, received an outstanding performance award from the ASHRAE international chairman for excelling in raising funds for ASHRAE research as the northeastern NY chapter research promotion chairman. He is now serving as treasurer of the chapter. . . . ASME President Ernest L. Daman has praised the choice

of John H. Sununu, PhD '66, as George Bush's chief-of-staff. "The Society looks favorably upon Governor Sununu's appointment because of his strong engineering background and ongoing commitment to the advancement of technology," Daman said in a press release. . . . MIT Associate Professor David C. Gossard, PhD '75, was a member of the National Research Council committee reporting on "Global Trends in Computer Technology and Their Impact on Export Control."

Elected to Fellow Grade of ASME last November: **Bharat S. Shiralkar**, ScD '69, a manager in the nuclear energy division of GE, San Jose, who has made major contributions to the field of boiling water nuclear reactor (BWR) thermal hydraulics and safety analysis; and **Joseph A. Wolf, Jr.**, ScD '67, a staff research engineer at GMC in Warren, Mich., who over the past 30 years has worked on dynamics, vibration, and structural mechanics, including rotor whirl, structural acoustics, the nuclear three-body problem, and vibrations of composite panels.

Walton Forstall, Jr., ScD '49, died on July 15, 1988, at the age of 79. He was the George Tallman Ladd Professor of Mechanical Engineering, Emeritus, at Carnegie-Mellon University, Pittsburgh.

III MATERIALS SCIENCE AND ENGINEERING

Hiroshi Menjo, SM '85, is currently working as a consultant for the Boston Consulting Group. His interests include American and Japanese competitiveness in high technology, internal entrepreneurship, and venture start-up. . . . **T. David Burleigh**, PhD '85, completed his postdoctoral research in West Berlin and is now a senior engineer at Alcoa Labs. . . . **Thomas F. Kelly**, PhD '82, was granted tenure last fall by the University of Wisconsin-Madison, Department of Materials Science and Engineering. . . . **Phillip H. Smith III**, MTE '52, writes that he is actively managing a private merchant bank, Smith Yuill & Co. Inc., specializing in technology transfer and investing between the U.S., Australia, and New Zealand. He is also lecturing on turnaround management in those three countries and the People's Republic of China. . . . **Donald Ritter**, ScD '66 (R-Pa.), was one of the five MIT degree holders reelected to Congress in November.

The Minerals, Metals & Materials Society's Leadership Award has been presented to **Peter R. Bridenbaugh**, PhD '68, vice-president of R&D at Alcoa Laboratories. He was selected for "establishing Alcoa's leadership in the development of advanced materials and for emergence of Alcoa Labs as a preeminent scientific and engineering institution." . . . **Richard W. Hertzberg**, SM '61, has been named chairman of the Department of Materials Science and Engineering at Lehigh University in Bethlehem, Pa. His field is fatigue in metals, polymers, and composites. . . . New from Academy Books: *Life, Science and Religious Concerns: Their Interrelations and Life's Meaning* by **Herbert H. Uhlig**, PhD '32, emeritus professor of metallurgy, MIT.

IV ARCHITECTURE

Russ V.V. Bradley, Jr., MAR '71, writes that he "married Catherine Biner, a Swiss lawyer I met in Boston, last May in Zermatt. I have moved to Geneva where we practice law together in the old city; baby expected in May. Look forward to seeing classmates who pass through for skiing or climbing (or who have opened Swiss bank accounts)." . . . After three years in Miami, **Norris Strawbridge**, MAR '76, reports that he is back in Boston, working hard at Sasaki as principal for urban design and architectural projects, including renovation of a 2600-seat theater in Miami Beach and a new concert hall for Bethel College in St. Paul, Minn. . . . Another Sasaki principal, **Mary Martha Lampkin**, MAA '81, has been elected to



President Ronald Reagan presents John R. Stopfel with the Historic Preservation Award for renovation of Boston's Horticultural Hall.

the board of directors of the Boston Society of Architects as Commissioner of Design.

Chris Mathis, SM '82, is currently manager of the Insulation and Fenestration Product Certification Programs of the NAHB National Research Center. He recently had two technical papers published by ASTM, focusing on the performance of loose-fill building insulations. . . . **Aron Faegre**, MAR '76, and his A/E firm have been working on several architectural projects at Portland International Airport with **Sheldon Klapper**, SM '78, who is manager of aviation planning and property development for the port of Portland. . . . **Takashi Arioka**, SM '86, writes that he and his senior colleagues of Kume Architects-Engineers won the 1988 urban design competition for their development proposal for Ohi-machi, Saitama Prefecture, Japan. It is composed of two 22-story, high-rise condominium towers and outdoor shopping mall with three-story shops and housing; construction begins this year.

Joseph Siry, PhD '84, assistant professor of art at Wesleyan University, is the author of *Carson Pirie Scott: Louis Sullivan and the Chicago Department Store* (Univ. of Chicago Press, 1989, \$39.95). . . . **Alan B. Dolmarch**, MAR '68, has been a principal at Aldrich, Eastman, and Walth, real estate investment advisors, for the past three years.

Three awards were received last year by **Rex M. Ball**, MAR '58, and HTB, Inc., of which he is chairman and CEO: the 1988 Governor's Art Award to Ball for his lifelong commitment to the Oklahoma cultural climate; the AIA Oklahoma Chapter's Outstanding Firm of the Year award to HTB; and the 1988 Corporate Humanitarian of the Year from the Gannett Foundation's KOCO-TV 5, awarded during a live telecast for HTB's long-standing commitment to economic development, education, and cultural enrichment. . . . **Roger K. Lewis**, MAR '67, is the recipient of a Federal Design Achievement Award, the highest design award bestowed by the National Endowment for the Arts. Lewis shared the award with his partner, John W. Hill, for an elderly-housing project completed in Maryland in the early 1980's on the eastern side of Chesapeake Bay.

The Compton Gallery was the site of a two-month-long exhibit this winter of the drawings, paintings, and sculpture of **Richard Filipowski**,



M.M. Lampkin



A.D. Mallows

associate professor of visual design emeritus, MIT. . . . Ronald Reagan presented **John R. (Dick) Stopfel**, MAR '60, with the President's Historic Preservation Award in Washington, D.C., last fall. The award, given for excellence in privately funded projects, recognized the Horticultural Hall restoration and rehabilitation designed by Stopfel-Miller, Inc., of Boston. The award jury's review said that the renovation "represents a successful mixture of old and new architecture required to update a building that has functionally outlived aspects of its original design." . . . **Anthony D. Mallows**, MAA '81, has been appointed Director of Planning and Urban Design at Jung/Brannen Associates, Inc., of Boston. He was a Merit Award winner in the National Design Competition for Copley Square in Boston, and lives in Somerville, Mass., with his wife and daughter.

Word has reached the Alumni Association of the death of **Jay E. Ricks** on September 6, 1987. No further information was provided. . . . **Richardson M. Courtney**, MCP '52, died on June 19, 1988, in Sarasota, Fla., after a long illness. He was 68 years old, and had formerly lived in Dayton, Ohio, for many years.

V CHEMISTRY

Mark A. Smith, SM '78, reports that he is an assistant professor in the Department of Chemistry at the University of Arizona. He was recently the recipient of the American Society of Mass Spectrometry's 1988 Research Award sponsored by the Finnigan-Mat Corp. . . . **Jeffery S. Carter**, PhD '86, is research investigator at the NutraSweet Company in Mt. Prospect, Ill. . . . **Uri Zoller**, SM '72, has resumed his position as head of the Division of Chemical Studies at Haifa University-Oranim, Israel, after a two-year sabbatical at the University of British Columbia in Vancouver. There he had a joint appointment in the Departments of Chemistry and Mathematics & Science Education.

Romas J. Kazlauskas, PhD '82, has moved from New York State to Montreal and has a new job as assistant professor at McGill University. . . . **Leslie L. Isaacs**, PhD '60, became associate dean of the School of Engineering, City College of New York, last fall.

After a sabbatical year doing laser plasma spectroscopy at the Naval Air Development Center, **Allan L. Smith**, PhD '65, is back at Drexel, where he is program chairman for the Division of Computers in Chemistry of the ACS, and president of SigMAChem, a newly formed national special-interest group of Macintosh users in chemistry.

A. Truman Schwartz, PhD '63, was named the 1988 Minnesota College Science Teacher of the Year. . . . **John M. Alexander, Jr.**, PhD '57, served as chairman of the Division of Nuclear Chemistry and Technology of the ACS in 1988. . . . Currently on leave from the University of Maryland-College Park, **Samuel O. Grim**, PhD '60, is a "rotator" at NSF in the Inorganic, Bioinorganic, and Organometallic Chemistry Program until September 1989.

Kevin Edward Gilbert, PhD '74, writes that he is "founder and president of Serena Software, which specializes in computational chemistry and computer graphics for microcomputers and workstations. The job requires that I be a physical, inorganic, bio, organic chemist in order to handle the chemical systems of interest to us."

From Santa Fe, **Ross U. Robinson**, SM '53, reports that he now is participating in a series of technology-based start-ups after a career at Abbott Laboratories and Boehringer Mannheim. He is the executive vice-president of Los Alamos Diagnostics and president of Los Alamos Economic Development Corp. . . . **Robinson D. Burbank**, PhD '50, retired from Bell Labs in 1986 after 31 years. He was president of the American Crystallographic Assoc. in 1975, and the treasurer from 1965-68, and his recreational interests include hiking, telemark and back-country skiing, and the Metropoli-

tan Opera.

Richard P. English, PhD '70, sent word that he left chemistry years ago, and left the industry in 1987 to began management consulting. He has started his own consulting practice to focus on operations management issues in equipment manufacturing industries. . . . **Peter P. Policastro**, PhD '83, has been appointed manager of the Specialty Polymers Program at GE Corporate R&D in Schenectady, N.Y. . . . From Allentown, Pa., **Gary L. Smith**, SM '80, writes that he is a principal applications chemist in the Performance Chemicals Group at Air Products and Chemicals. . . . **Patricia A. Mabrouk**, PhD '88, was just awarded an NIH postdoctoral fellowship for two years to work with Professor E.L. Solomon at Stanford University.

Joseph S. Francisco, PhD '83, an assistant professor of chemistry at Wayne State University in Detroit, has received one of 15 NSF Presidential Young Investigator Awards given in 1988. The award, plus industry contributions, could total \$500,000 over the next five years. It will help fund Francisco's research into the use of laser chemistry to put more information on microelectronic chips, and his studies of the role of halocarbons in depletion of the earth's ozone layer and possible halocarbon alternatives for industrial use. . . . New from Academy Books: *Life, Science and Religious Concerns: Their Interrelations and Life's Meaning* by **Herbert H. Uhlig**, PhD '32, emeritus professor of metallurgy, MIT.

Several accolades to department faculty members: Professor **Stephen L. Buchwald** received a 1988 Camille & Henry Dreyfus Teacher-Scholar Award last fall. . . . In March, Professor **Klaus Biemann** was presented with the Maurice F. Hasler Award from the Spectroscopy Society of Pittsburgh for his work in mass spectroscopy, particularly in the area of high resolution spectroscopy of biomolecules. . . . Associate Professor **Sylvia T. Ceyer** has received the 1988 American Association of University Women's Recognition Award for Young Scholars. Her research has concentrated on the rearrangement of molecules in surface chemistry, with emphasis on the conversion of natural gas to useable fuels. . . . A two-and-a-half-day symposium commemorating the sesquicentennial of the birth of Josiah Willard Gibbs will be held at Yale in May. One of the sixteen leading scientists presenting papers dealing with Gibbsian themes in physical chemistry, mathematical physics, mathematics, and other areas, will be MIT Professor **Irwin Oppenheim**.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

H. Newton Garber, ScD '56, is with Merrill Lynch & Co., Inc., as first vice-president and director of its Management Science Group. . . . **Thomas Kailath**, ScD '61, was recently named the first recipient of the Hitachi America Professorship in Engineering at Stanford University. . . . "We spend six months in each of two places," writes **Wesley W. Pendleton**, SM '40, "in winter, Zephyrhills, Fla., and in summer, Muskegon, Mich." . . . **Michel Kubacsi**, SM '81, of Meyzieu, France, reports that he is working on the electronics involved in washing machines. . . . **Richard J. Robbins**, SM '70, has been promoted from engineering manager to vice-president of engineering at Metrabyte Corp. in Taunton, Mass. . . . **Jim Sitomer**, SM '61, founder and former president of G&S Systems, Inc., a developer and producer of simulation and training equipment for weapon systems, has been named Director of Business Development at the Charles Stark Draper Laboratory.

William M. Crampton, SM '55, reports that after retiring from Honeywell, Inc., last year, he and his wife, Jeanne, moved to rural Bear Lake, Mich., where they winterized a summer cottage, put in a wood stove, and plan on living there year-round. . . . After 11 years at Rensselaer Polytechnic Institute, **James M. Tien**, PhD '72,

was appointed chairman of a new interdisciplinary Department of Decision Sciences and Engineering Systems last July, which include programs industrial and management engineering, operations research, statistics, management information systems, and management systems. . . . **Arthur Fox**, SM '72, writes that he "is using the expertise gained from co-founding three technology companies (Medicel, Inc., Lexidata Corp., and Octek, Inc.) in forming Arthur L. Fox Associates, a consultancy that focuses on solving the problems of development-stage technology companies.

After 14 years as director of the University of Texas at Austin's Center for Energy Studies, **Herbert H. Woodson**, ScD '56, has resigned to become dean of engineering at UT. . . . **Alexander Kusko**, ScD '51, lecturer in electrical engineering, is the author of *Emergency/Standby Power Systems* (McGraw-Hill, 1989). His consulting engineering company is now operating as the Kusko Electrical Division of Failure Analysis Associates, located in Westborough, Mass. . . . Two of the 15 assistant professors appointed at Princeton last fall are Course VI grads: **David Flamm**, PhD '86, has been appointed in electrical engineering—his areas are control, modeling, and identification of large space structures, and design of robust control systems; and **Elisha Sacks**, PhD '88, whose fields of interest include qualitative reasoning, dynamic systems, inequality reasoning, and knowledge representation, was appointed to the Computer Science Department.

John E. Ward, SM '47, founder of MIT's Laboratory for Computer Sciences and a lecturer in electrical engineering at the Institute for 44 years, died on December 11 at his home in Lexington, Mass. Before his retirement in 1987, Ward was deputy director of MIT's Electronic Systems Laboratory, and he drew up technical specifications for cable television stations, including Boston's. . . . **Alfred K. Susskind**, SM '50, died on December 10 of cancer after a short illness. He took early retirement from Lehigh University in 1987 and was a program director (rotator) with the Division of Microelectronics Information Processing Systems at the National Science Foundation. He lived in Bethesda, Md.

VI-A INTERNSHIP PROGRAM

It's now just after the holidays as I write this April column, and beside me is a pile of greeting cards from Course VI alumni—many containing notes bringing us up to date on their senders' lives. These are always much appreciated.

1988 was the biennial year for a meeting of Course VI's Corporation Visiting Committee. Six of the 18 committee members are VI-A graduates: **Joseph F. Keithley**, SM '38; **John G. Linvill**, ScD '49; **H. DuBose Montgomery**, SM '72; **Raymond S. Stata**, SM '58; **William R. Thurston**, SM '48; and **Andrew J. Viterbi**, SM '57. I had a short chat with each of them during their visit last December.

The 1988 November/December issue of *National Gram*, a publication of National Semiconductor Corp., carries an article entitled "Engineering, Medicine Combine to Save Lives." The article describes the use of a mannequin for training anesthesiologists in real time emergencies. The "real time" operational idea came from Stanford medical student **John D. Williams**, SM '77, whose engineering background led him to suggest downloading the simulating computers to use micro-controllers to make the simulation operate in the real world by directly controlling the mannequin and the operating room instruments. As a VI-A student, John had his assignments with the Hewlett-Packard Co./Cupertino where he developed one of the earliest computer-aided design programs.

A chance meeting on campus with **David E. Abrams**, SM '77, brought the information that he is with Galactic Industries Corp., Salem, NH, and the White Mountain Computer Co., a store in Nashua, NH.

While here for a professional visit with Professor **D. Antoniadis** in our Microsystems Center, **Andrew L. Robinson**, PhD '84, stopped by for a visit. Andy is on the faculty at the University of Michigan/Ann Arbor and has two children. He informed me that **Fred L. Terry, Jr.**, PhD '85, is also on the Michigan faculty and occupies an office next to his.

At our Department Christmas Luncheon, I had a surprise meeting with **H. Roland Zapp**, SM '65, who is a brother-in-law of Professor **Roger G. Mark**, PhD '66, and here for a visit. Roland went on to Stanford for a doctorate and is now on the faculty at Michigan State University.

Michael E. Amirault, '87, has completed his graduate work and has accepted a position with Teradyne in Boston.

And I just had a visit from **Moses H. Ma**, SM '81, with a receipt in hand for his doctoral thesis. Moses is currently employed by NYNEX Corp. at their White Plains, NY, headquarters.

Annual admissions decisions on VI-A seniors to the graduate phase of the Program are almost complete. So far (as of January) 63 percent have gained admission. It is expected that this percentage will rise slightly when the final results are in. VI-Aers continue to be high academic achievers among their classmates.—John A. Tucker, Special Assistant to the Department Head for VI-A and Lecturer, MIT, Room 38-473, Cambridge, MA 02139.

VIII PHYSICS

Professor **Bruno Coppi** of MIT has been awarded the 1988 European Biancamano Prize for Scientific research, along with Professor Renato Dulbecco of the Salk Institute, the 1975 Nobel laureate for medicine or physiology. The citation said that Coppi has made "fundamental contributions to the theory of both laboratory and space plasmas. He has conceived and developed experimental machines of the Alcator type . . . that have opened a new field of research on nuclear fusion. He is also the originator of the Ignitor concept and project for the scientific demonstration of the feasibility of a self-sustained thermonuclear fusion reactor."

Fuad U. Muhammad, PhD '87, an instructor of physics at the University of Maryland, has been elected a member of the MIT Corporation. . . . **James E. Brau**, PhD '78, is now a professor of physics at the University of Oregon. . . . The U.S. Department of Energy has awarded its highest scientific award, the (1988) Enrico Fermi Award, to Institute Professor **Victor F. Weisskopf** and Richard B. Setlow, associate director for Life Sciences at the DOE's Brookhaven National Laboratory. Weisskopf's citation reads: "For many unique contributions to particle and nuclear physics, and to physics in general as a researcher, educator, and statesman of science.

From New York City, **Kenneth G. McKay**, ScD '41, writes that he was the keynote speaker in November at the International Opto-Electronics Conference in Kobe, Japan. "It is an exciting field and the Japanese are making it more exciting," he says. McKay, retired as chairman of the Charles Stark Draper Laboratory, Inc., is also serving on the NAE Film Committee, one of three organizations working on a new public television series, *Great Projects: Engineering in Society*. The six-part series will explore the technical feats and societal impact of large-scale civil engineering projects such as the Hoover Dam, the Panama Canal, and others both existing and on the drawing board. The NAE committee will be responsible for ensuring the engineering and scientific accuracy of the program. Also on the film committee is **Jordan J. Baruch**, ScD '50 (VI). The programs are expected to air in the fall of 1990.

Angelo A. Molinaro, '54 (VI), reports that in addition to his work as senior engineer at Sikorsky Aircraft, he is a published author. His book, *The Two State Universe*, introduces a new

theory of the universe, which "proposes that the universe is neither a single state nor a three- or four-dimensional universe, but a two-state universe in which everything exists as complements and complements can exist only if they are kept separated in time or space," writes Molinaro. The book also includes a new theory of gravity as the attraction between the complements of mass and energy. "Using the new theory, I derive a unified field theory which amazingly and unexpectedly verified the new gravitational equation," he adds.

IX BRAIN AND COGNITIVE SCIENCES

Eldar Shafir, PhD '88, was appointed last November to Princeton's psychology department as an assistant professor. His interests include human judgment and reasoning, choice and decision making, inductive inference, concepts and conceptual structure, and knowledge and belief formation. . . . The Gustavus Myers Center of the University of Arkansas has selected *The Chomsky Reader* as an outstanding book published in 1987 on the subject of intolerance in the US. The center is named in honor of the author of the *History of Bigotry in the United States*. . . . MIT Assistant Professor **Arthur D. Lander** has received a \$500,000 five-year research fellowship in science and engineering from the David and Lucile Packard Foundation. . . .

Professor **Richard J. Wurtman** and research scientist **Judith J. Wurtman**, both of MIT, are the authors of "Carbohydrates and Depression" in the January 1989 issue of *Scientific American*. The article is an update on their work linking seasonal affective disorder (SAD), carbohydrate-craving obesity (CCO), and premenstrual syndrome (PMS)—behavioral disorders characterized by disturbances of appetite and mood.

X CHEMICAL ENGINEERING

Professor **Robert A. Brown** has been named to succeed **James Wei**, ScD '55, as head of the MIT Department of Chemical Engineering. He is an expert in fluid mechanics, transport processes, and numerical methods. Professor Wei will return to teaching and research. He is also stepping down as president of AIChE. . . . Professor Emeritus **Janos M. Beer** has been awarded the Percy Nicholls Award of the American Society of Mechanical Engineers and the American Institute of Mining, Metallurgical, and Petroleum Engineers "in recognition of outstanding achievement in the field of solid fuel science and technology."

From Goleta, Calif., **William K. Fraizer**, SM '80, reports that he is serving as senior chemical process engineer on the Gaviota Oil & Gas Plant staff. He spent the first half of last year as plant engineering supervisor, and then worked on a task group reviewing their supplemental environmental impact report. He also took time out to visit old Practice School classmate **Bruce Reynolds**, SM '80, in Arizona for a week. . . . **Alan H. Bergman**, SM '58, is vice-president and general manager of the Adhesives Division at National Starch & Chemical Corp., and is responsible for the activities of the domestic (U.S.) adhesives and sealant business.

John E. Bigelow, ScD '56, is currently project coordinator for the Californium-252 distribution center at the Oak Ridge National Laboratory. "From here, the U.S. Dept. of Energy supplies this unique and valuable radioisotope for many uses by the armed forces, and in industry, education, research, and cancer therapy," he writes.

Robert W. David, SM '50, has been president of the Chevron Chemical Co. since 1982. He is also a vice-president of the Chevron Corp., a member of the board of directors of the CMA, and vice-chairman of the board of the Bay Area

chapter of the Red Cross. . . . **David Brown**, SM '40, sends word that he has retired to Key Largo, Fla., in winter and Highlands, N.C., in summer. He keeps "totally busy" with his interests in music and business & financial literature. . . . **Francis L. Shackelford**, SM '40, writes that "we have moved into Stonegates, a retirement community, in October. With no regrets we left two acres of yard, a well, and a septic tank."

Joseph Byrne, ScD '50, has been accepted to Southwestern University School of Law's intensive two-year SCALE (Southwestern's Conceptual Approach to Legal Education) program leading to the Juris Doctor degree. He was formerly the vice-president of human resources for Unocal Corp. . . . **Thomas H. Goodgame**, ScD '53, and his wife recently returned from Santo Domingo, Dominican Republic, where he had been serving as a volunteer with the International Executive Service Corps (IESC). Currently the president of Environmental & Chemical Consulting Engineers, Inc., and retired director of Environmental Control at Whirlpool Corp., Goodgame was recruited by IESC to assist Interquímica, S.A., in analyzing the environmental impact the client company may have on the surrounding area that could affect the health and well-being of the nearby inhabitants.

The Alumni Association has been notified of the death of **Jay H. Forrester**, SM '32, on September 5, 1988. No further information is available.

XI URBAN STUDIES AND PLANNING

Bennet Harrison, professor of political economy and planning at MIT, has recently won a grant from the Ford Foundation and the Aspen Institute to continue his research on growing inequality in the distribution of labor income. His new book, co-written with Barry Bluestone, *The Great U-Turn: Corporate Restructuring and Polarizing of America*, was Inc. magazine's October book of the month. In addition to now being a regular columnist for *Technology Review*, Harrison will represent MIT this spring as a visiting exchange fellow at Balliol College, Oxford University, while also conducting Fulbright-sponsored research on the stability of large firm-small firm business transactions in the U.S., United Kingdom, Germany, and Italy.

Irwin Jay Kugelman, ScD '63, presented an invited paper on "Biological Nitrogen Removal in Activated Sludge" in Tokyo last spring at the U.S.-Japan Water Pollution Conference. . . .

Philippe E. Annez, PhD '81, reports that he is now the chief of the regional mission of the World Bank in Bangkok, covering Thailand, Burma, Lao P.D.R., and Vietnam.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Carl I. Wunsch, PhD '67, Cecil and Ida Green Professor of Physical Oceanography and Secretary of the Navy Research Professor, has received the A.G. Huntsman Award, established by the Bedford Institute of Oceanography in Nova Scotia to recognize excellence of research in and outstanding contribution to the marine sciences. He was cited for giving oceanographers "a new global perspective of the oceans and their integration into the global climate system" through his application of "powerful numerical analysis techniques to both historical and recent ocean data sets." . . . Professor Emeritus of Meteorology **Edward N. Lorenz**, ScD '48, received the honorary degree of Doctor of Science at the winter commencement of the University of Arizona for his "distinguished contributions in atmospheric science over the years."

George H. Beall, PhD '62, a research fellow at Corning Glass Works, is the 1988 recipient of the George W. Morey Award from the glass division



G.H. Beall

of the American Ceramic Society. The award recognizes Beall's numerous publications in the field of glass-ceramics.

MIT doctoral student **Chantal Rivest** has been awarded her second Zonta Amelia Earhart Fellowship award. She will use the \$6,000 grant to pursue her studies in cyclonic scale mid-latitude upper-level waves, which may induce the development of storms.

XIII OCEAN ENGINEERING

Hank Moravec, NE '60, writes that he has started a third career, "at a much slower pace than previously, as a general partner in HARGUS consultants. The work site is on the Italian Riviera, near La Spezia, where we are assisting an Italian ship designer/builder in transferring fiberglass technology to the USN." . . . Retired Commander **Francis A. Packer, Jr.**, NE '51, reports that he keeps his "hand in" as an adjunct professor of math at Kean College in New Jersey. . . . **Larry K. Donovan**, SM '71, was recently promoted to manager of advanced security and special projects for the defense and space business line of Bechtel National, Inc. His primary client area is high tech, secure facilities, and DOD classified projects. He and his wife Judi live in Walnut Creek, Calif.

Carl E. Hanson, PhD '70, is vice-president of Harris Miller Miller & Hanson, Inc., in Lexington, Mass., an acoustical consulting firm. . . . **Richard F. Elliott**, SM '69, has been promoted from vice-president of operations to president of H.B. Ives, a manufacturer of builders and home hardware in Wallingford, Conn.

Lieut. Cdr. **Geoffrey L. Abbott**, OCE '82, will be presenting a paper on "The Challenge of Preserving Our Nation's Lighthouses" at the Coastal Zone '89 Conference in Charleston, S.C., in July. "Am enjoying learning about fatherhood from our son Matthew Geoffrey, who was born last May," Abbott writes.

Classmate **Thomas R. Robinson**, OCE '82, and his wife Mary also had a baby boy last year. Robinson retired from the navy in August after 22 years of service, and was expecting to start the PhD program in engineering management at Old Dominion University, Norfolk, Va., in January.

George A. Uberti, SM '54, was elected a Fellow of the Society of Naval Architects & Marine Engineers in 1987. He retired from National Steel and Shipbuilding Co. at the end of last year. . . . "Retired from Booz, Allen & Hamilton, Inc., as senior vice-president after 20 years with the firm managing consulting work in defense, space, and advanced manufacturing technology," reports **Peter W. Wood**, NE '55. "Am now a consultant in space commercialization, based in Alexandria, Va., and a life member of the corporation of the International Space University. . . . **Donald P. Courtsal**, SM '56, sends word that he continues to work as a financial consultant in Pittsburgh; his younger son is finishing his last year of medical school. . . . **V. Daniel Hunt**, SM '48, is the author of the *Superconductivity Sourcebook* (John Wiley & Sons, Inc., 1988, \$34.95), a "comprehensive, up-to-date, and highly authoritative overview . . . featuring more than 600 superconductivity-related definitions, acronyms,

and references," according to the press release.

The death of **John A. Leary II**, NE '65, on September 7, 1986, has been reported; no further information is available.

XIV ECONOMICS

Abt Associates, Inc., an applied research and management consulting firm in Cambridge, has named **Stephen D. Kennedy**, PhD '72, to the post of chief social scientist. An expert in the design and management of policy research, Kennedy has been with Abt for 20 years, and in his new position will serve as watchdog over the company's internal quality-control program and provide technical leadership. . . . MIT economist **Paul W. Krugman**, PhD '77, told the *New York Times* that an expected downward revision of U.S. manufacturing figures by the Commerce Dept. might bring them more into line with what Americans already have sensed about the economy. "There's nothing you can reach out and touch that tells you manufacturing is only 19 or 20 percent of the economy now, instead of 21 or 22 percent, as the statistics report," he said, "but you can see that Americans are buying more Japanese cars and gadgets." . . . **Les Aspin**, PhD '66 (D-Wisc.), was one of five incumbent MIT graduates reelected to Congress in November. . . . One of this year's 15 visiting scholars at MIT's Center for International Studies is **Robert E.B. Lucas**, PhD '73; his areas of study are employment in Zimbabwe and India, and industrial reform in India.

Lawrence S. Bacow, '72, director of research at MIT's Center for Real Estate Development (CRED), is the author of a study on "The Internationalization of the U.S. Real Estate Industry," a follow-up to his 1987 paper, "Understanding Foreign Investment in U.S. Real Estate." According to the study, conducted by CRED in conjunction with the National Association of Realtors, offshore investors are not limiting themselves to coastal U.S. cities. For example, the Japanese have been buying aggressively in Chicago during the past two years, and Phoenix has experienced a rapid growth in development activity by investors from Canada, Norway, Belgium, and Great Britain, as well as Japan.

Charles Kindleberger, Ford International Professor of Economics Emeritus at MIT, is the author of *The International Economic Order: Essays on Financial Crisis and International Public Goods* (MIT Press, 1988, \$35). . . . *The Impact of Technological Change on Employment and Economic Growth* (Ballinger, 1988) contains three papers by department graduates: "The Changing Pattern of Industrial Robot Use" by **Kenneth Flamm**, PhD '79, "Computers and Jobs: Services and the New Mode of Production" by **Larry Hirschhorn**, PhD '71, and "Technology, Structural Change, and Trade" by **C. Michael Aho**, PhD '74. . . . **Robert J. Shiller**, PhD '72, is the co-author of "The Behavior of Home Buyers in Boom and Post-Boom Markets," appearing in the *New England Economic Review* of the Federal Reserve Bank of Boston.

XV MANAGEMENT

James F. Burns, PhD '67, teaches courses in conflict resolution at the University of Florida and has written over 50 popular-press pieces on the Northern Ireland conflict, including articles in the *Christian Science Monitor* and *USA Today*. . . . **Thomas L. Pappas**, SM '87, was recently awarded the Chartered Financial Analyst (CFA) designation. . . . **Yin-Fee F. Ho**, SM '77, has a one-year-old daughter and is working as a financial analyst for an investment management company specializing in investing in small- to medium-sized companies. . . . **Bryan T. St. Amant**, SM '86, married Sheri R. Greene last fall—and "did not run into anyone from MIT in Tahiti!" he reports.

Stuart Scott, Jr., SM '83, recently joined Frenkel



S.D. Kennedy

J.S. Schwendiman

& Co., Inc. in New York as a vice-president and unit manager. . . . **Pierre L. Guillaume**, SM '84, has joined the Strategic Systems Group (SSG) as a vice-president. SSG is a start-up consulting firm specializing in the implementation of information systems geared toward strategy analysis. . . . **Edward J. Weisberg**, SM '81, is the Northeast regional sales manager for BASF Corp. Information Systems in the audio video division. He and his wife Diane had a son last November. . . . **Michael A. Connolly**, SM '82, is director of volunteer resources for the AIDS Action Committee of Mass. "With a budget of \$6 million, 75 employees, and 1100 volunteers," he writes, "this multipurpose community-based organization is a fascinating and rewarding place to put into practice lots of what I learned at Sloan. Best to all!" . . . Taking a year's sabbatical from his job as dean of operations at Concord Academy, **Paul M. Ness**, SM '80, is on a Klingenstein Fellowship at Columbia University. . . . **Mary E. Cross**, SM '80, sends word that she and her husband **Jack P. Salerno**, PhD '83 (III) have a one-year-old daughter.

David Handmaker, SM '86, reports that he recently saw classmates **Chris Jenkins**, SM '86, **Mark Aisenberg**, SM '86, and **Elan R. Bair**, SM '86, and spouses "at Elan's beautiful new home. Everybody's doing well, happy, and having fun. Bair himself writes that he and **David I. Rosen**, SM '85, have joined Temple, Barker & Sloane to start a technology management practice within the strategy group. Elan and his wife Alma had a son last year. . . . **Thomas A. Gardner, Jr.**, SM '88, is serving as executive officer onboard the future USS *Alexandria* (SSN 757), a new construction submarine at Electric Boat, Groton, Conn. . . . **Bradley J. Goldhar**, SM '85, is currently vice-president of corporate finance with Wood Gundy, Inc., Canada's leading investment bank. . . . Recently elected to the board of trustees of Heidelberg College in Tiffin, Ohio, **Philip A. Stevens**, SM '58, is also still director of Stevens Consulting Group, registered investment advisors. . . . **Cdr. Robert M. Fortson III**, SM '74, is the director of Total Quality Management at the Norfolk Naval Shipyard.

Joseph P. Carroll, SM '66, has added the title of president to his others at Cambridge Medical Technology in Billerica, Mass. He is also chairman and CEO. . . . **Thomas P. Marrie**, SM '64, has kept his titles of executive vice-president and CFO, but has moved up from First Interstate Bank of California to its parent, First Interstate Bancorp. . . . From vice-president of marketing at Access Technology, Inc., of South Natick, Mass., **Carl E. Nelson**, SM '80, has become president and COO of the company. . . . From **Christina T. Schoen**, SM '85: "Last November I started a new job with an Austrian bank, Creditanstalt, in New York, in their leveraged finance group. While demanding, it's very interesting, and I might even be sent to Vienna for six months!" . . . Physician **Steven R. Peskin**, SM '87, is medical director of Managed Health Care at John Hancock. He continues to practice medicine part-time at New England Medical Center, is senior clinical instructor in the Department of Medicine, and was expecting his first child in January.

Laurence B. Timm, SM '83, recently joined Novellus Systems, Inc., a start-up manufacturer

of chemical vapor deposition systems for the semiconductor industry. He is an account executive with responsibility for major manufacturers in Silicon Valley and Southern California. . . .

Ronald M. Weiers, SM '65, has had the second edition of his *Marketing Research* published by Prentice-Hall, and he's now completing the *Introduction to Business Statistics*, to be published by Dryden Press. . . . **Alexis Falquier**, SM '67, coordinated the Mexican Institute of Financial Executives Presidential White Paper on "Financing of Mexico's Next Stage of Growth," presented to the Ministry of Finance last November. . . . **David H. Sossen**, SM '87, reports the birth of his first child, a daughter, last August. . . . From being manager of quality engineering at Midland Ross Corp's Grimes Division in Urbana, Ohio, **Robert H. Brooke**, SM '82, has become manager of quality assurance at Systems Research Laboratories, Inc., of Dayton, Ohio. The latter is an operating division of Arvin/Calspan, a subsidiary of Arvin Industries, Inc.

After spending his entire professional career in Chicago, **L. Cutler Umbach**, SM '56, has moved to McCall, Idaho. "I raise llamas," he writes, "am starting an outfitting business, and do a little consulting in organizational development and strategic planning [as High Lakes Research and Consulting]. Only wish I had done it 20 years ago!" . . . Umbach's classmate, **George W. Patterson III**, SM '56, who is with the General Services Administration in Boston, is enthusiastic about a much more modest change of scene: "Returning to MIT as a 30-year graduate alumnus is even more enriching in continuing education. . . . Media Lab, computer user groups, alumni seminars, entrepreneurial meetings, architecture—all focused on the advancing field of computer/information systems. . . ."

Professor **James M. Utterback**, PhD '69, has stepped down as director of MIT's Industrial Liaison Program to return to teaching and research in the School of Engineering. He will continue to teach a course titled "The Manufacturing/Technology Interface," and is involved in the new Leaders for Manufacturing program. . . . **Clay Johnson III**, SM '70, is president of Horchow Mail Order, recently purchased by and now a division of Neiman Marcus Group. "Very busy integrating mail order operations of Horchow and Neiman Marcus," he says. . . . In New York, **Marys E. Appleton**, SM '78, is vice-president and sales manager for U.S. Government Securities, Swiss Bank Corp. . . . **David S. Grant**, SM '80, owner of Grant Emblems Ltd., writes: "Joanne and I are moving with our two children to Leviston, N.Y., in the spring. Our business is growing strongly in a number of different directions, including the completion of a factory in India, which has proven to be a fascinating/learning experience." . . . **Jorge R. Peschiera**, SM '75, is currently senior vice-president and manager of international banking at Atlantic Security Bank in Miami. . . . Ballinger has recently published two companion books: the second edition of *Readings in the Management of Innovation*, edited by **Michael L. Tushman**, PhD '76, and **William L. Moore**, and *Managing Professionals in Innovative Organization: A Collection of Readings*, edited by **Ralph Katz**. Each includes numerous articles by Sloan faculty and alumni, among others. . . . **Amar Gupta**, SM '80, principal research associate at Sloan, and **Bandreddi E. Prasad** are the co-editors of two books published by the IEEE Press last fall: *Principles of Expert Systems and Microcomputer-Based Expert Systems*.

John Brown, Inc., a global manufacturer of plastics and textile processing machinery headquartered in Rhode Island, has announced the appointment of **John S. Schwendiman**, PhD '71, formerly with Dow Chemical Co. for 17 years, as vice-president for business development. He will be in charge of activities leading to acquisitions, joint-ventures, and strategic business relationships worldwide. . . . **Krishna Palepu**, PhD '83, an expert in financial analysis and reporting, has been promoted to associate professor at the Harvard

Business School. His current primary areas of research are the information conveyed by changes in corporate financial policies, such as dividend policy and debt policy, and the long-term effects of major corporate takeovers on acquiring companies and their stockholders. This second study will also address whether such acquisitions are beneficial for the economy. . . . **Joe Lehmann**, SM '85, reports: "I recently joined a start-up manufacturer of diagnostic blood tests called Cytosignet. At this point we are a two-person company, with few problems at the marketing-technology interface: in the morning I make products in the lab, and in the afternoon I try to sell them! My wife Jeanne and I are enjoying our son Alex, who helps put our jobs into perspective by showing us what hard work it is to be a one-year-old." . . . "Left Bain & Co. and returned to Eastman Kodak as a program manager in the Consumer Products Division," writes **John Chun Bay**, SM '87. "Feels great to be back in a real company that makes products, rather than in the service sector."

A short note from **Howard P. Sharp**, '34, says simply that he is retired. . . . **Linda P. Senne**, SM '77, is now manager of market development at Proteon, Inc., in Westborough, Mass. . . . "After appearing to have dropped off the face of the universe, I am back!" says **Nikhil Malvania**, SM '78. "Some changes in the last three years include marriage to a novelist and aspiring film-maker, Janice Lori Deaner. No little Nik or Janice yet. We are currently splitting time between New York and Washington—she is at NYU's film school and I am a vice-president at Strategic Planning Associates, Inc." . . . **James E. Donaghy**, SM '58, became president and COO of Sheldahl, Inc., of Northfield, Minn. two years ago after 29 years with E.I. DuPont Co. . . . **Lynn R. Garland**, SM '85, is living in Washington, D.C., and working as the material control manager of E-System's Melpor Division. . . . **J. Thomas Gormley III**, SM '87, is marketing manager at Oracle Corp. in a new division called Applications, producing financial applications software.

Max Coutts, '39, spends at least a quarter of his time on volunteer work, and was elected president of the Kiwanis Club of North Toronto recently. He and his wife, Adele have a young grandson whom they hope will follow in the footsteps of his father (**Gregory**, '77) and grandfather by attending MIT. . . . **Edmund Cinciarulo**, SM '65, writes that his company, the Bren Corp., "has managed to successfully blend today's technology and management sciences with yesterday's old-world artisan skills in leatherworking to profitably produce in this country labor-intensive, high-quality leather goods for a world-wide market—and it's fun!" . . . **Marla Choslovsky** and **Paul Greenberg**, both SM '88, got engaged shortly after graduation, and now admit that they collided in Professor **Robert S. Pindyck's** (PhD '71) Strategy Game. They "highly recommend that the Master's Program Office use matchmaking criteria in admissions decisions, but Professor Pindyck should not."

Alumni Association has been notified of the deaths of **Sandra R. Dean**, SM '80, in March 1985; of **Charles H. Meers**, '48, in Dallas, Texas, on April 8, 1988; and of **Paul H. Kalikstein**, SM '74, in White Plains, N.Y., on March 10, 1988. Kalikstein was president of the Promotion Network, New York, but further details are not available.

Sloan Fellows

Last June **LeRoy E. Day**, SM '60, lectured for two weeks at the Joint U.S.-China Management Institute in Chendu, China. . . . **David Znatty**, SM '79, writes that he "was just appointed as an expert and arbitrator for the International Chamber of Commerce (Paris) after four years as an expert witness for the Appeal Court of Paris in the field of hardware and software cases." . . . **Andrew G. Swanson**, SM '64, retired last June from NASA's Langley Research Center after 37 years of service. . . . **Alphonso V. Diaz**, SM '86, has been named

division vice-president for Space and Aeronautics Services, GE Government Services. The newly created position includes managing all Government Services' work for NASA, the FAA, and NOAA. . . . The AICHE's 1988 Robert E. Wilson Award was presented by the Nuclear Engineering Division to **Samuel J. Beard**, SM '69, a retired president and CEO of Advanced Nuclear Fuels Corp. (formerly known as Exxon Nuclear Co., Inc.) in Richland, Wash. . . . **Philip P. Panzarella**, SM '79, assistant deputy for acquisition logistics and aeronautical programs at Wright Patterson Air Force Base, has been selected to be Air Force Logistics Command's first full-time chief scientist/engineer.

From **Thomas J. Vincent**, SM '68: "Have retired this year from York International Corp., where I had been president and COO. For some time I will reside in Florida, but continue to maintain my house in Hawaii. Although 'retired,' I am quite busy with some consulting work in the Far East; in fact I am spending more than half my time in Asia, mainly in Thailand, Taiwan, and the Philippines." . . . After seven years with Lewis & Saunders, Inc., as executive vice-president and general manager, **Hermann Hintershaeuser**, SM '78, has been promoted to president and COO of the precision metal fabrication firm. . . . **Richard G. Bruner**, SM '64, has retired from the Defense Logistics Agency. . . . At Eastman Kodak Co., **Daniel A. Carp**, SM '88, general manager of Kodak's Latin American Region, has been elected a company vice-president. **Ernest W. Deavenport**, Jr., SM '85, has been promoted to group vice-president, and becomes president of the Eastman Chemicals Division.

Management of Technology Program

Richard H. Bullen, Jr., SM '82, president of Investor Support Systems, Inc., has recently published the first issue of the ISSI's new *Systems & Technology Letter*. The publication, also written by Rick, will appear quarterly and will comment on investment-oriented computer software, databases, books, and analytical techniques. . . . **John A. Harrison**, SM '83, is project manager for Parsons Brinckerhoff Quade & Douglas, Inc., in Jersey City, N.J. . . . **Koichi Kodama**, SM '84, is manager of the Technology Affairs Department at Mitsubishi Corp. of Tokyo. . . . **Virginia Moszkowicz**, SM '87, is a unit director at Eastman Kodak Co., and supervises a group of people doing chemical testing to support photographic and photocopier product manufacturing. She had an opportunity to visit **Tsuneo Kobayashi**, SM '87, in Japan, **Joe Manter**, SM '87, in Dayton, and **Karen Simms** and **John Pilat** (both SM '87) in Boston. "It was wonderful comparing notes on how our jobs were going. It was equally wonderful recalling all the great times we shared," she writes.—Cheryl Kelliher, Room E52-125, MIT, Cambridge, Mass. 02139.

Senior Executives

Henry Flickinger, '76, a former vice-president at Avco Systems Textron responsible for advanced technology development, has been named Director of Technology Development at the Charles Stark Draper Laboratory. . . . Two promotions to company vice-president at Eastman Kodak Co.: **Joerg D. Agin**, '88, general manager of the Motion Picture and Audiovisual Products Division within the Photographic Products Group, and **Tom O. Nethery**, '88, senior vice-president of Manufacturing for Eastman Chemicals Division.

The Alumni Association was notified of the death of **Hsiang Yun Chen**, '87, on April 2, 1988; no further information was provided.

XVI AERONAUTICS AND ASTRONAUTICS

MIT graduate student **Denise Avila de Melo** of Brazil has won a \$6,000 Zonta Amelia Earhart Fel-

lowship to further her studies in flight mechanics. After receiving her degree, she plans to work in the Brazilian aerospace industry. . . . **Edward Bokhour**, SM '88, is employed by Payload Systems, Inc., of Wellesley, Mass. as an instrumentation engineer. Projects include development of a next-generation life sciences microcomputer for NASA/JSC, experiment design support for MIT MODE/MACE middeck locker experiments, development of Preflight Adaption Trainer for astronaut training at NASA/JSC. . . . **Robert F. Weiss**, SM '59, writes, "I continue to serve as chairman of the board of Physical Sciences, Inc., in Andover, Mass., which has grown to 125 employees. In my capacity as president of Lynnfield Initiatives for Elders, Inc., I have helped to build 126 units of nonprofit elder housing, and am consulting in other communities with similar interests." . . . Lt. Col. **Robert E. Mitchell**, SM '52, is section manager of configuration requirements at McDonnell Douglas Helicopters in Mesa, Ariz.

Raymond B. Montgomery, ScD '38, died on August 15, 1988, of leukemia at his home in Woods Hole, Mass. From 1954 until his retirement in 1975, Montgomery had been a researcher and teacher of oceanography at The Johns Hopkins University. . . . Capt. **Bruce K. Lloyd, Jr.**, SM '47 (USN Ret.), of Newtown Square, Pa., died on August 25, 1987. With a reputation as a man who could fly anything, with or without wings, Lloyd was a test pilot for the Navy and, later, chief engineer for Boeing Vertol, where he was a specialist in helicopters and set world speed records in one built for the Navy by Sikorsky.

XVII POLITICAL SCIENCE

Sharon S. Russell, PhD '87, writes: "Since graduation, I have been a research affiliate at MIT's Center for International Studies and a long-term consultant for the World Bank. My research activities include international migration, the study of informal sector labor markets in Sub-Saharan Africa, and population and human resources development strategy in Cote d'Ivoire. . . . **Howard Wolpe**, PhD '67, was one of five incumbent MIT graduates reelected to Congress in November. . . . **Daniel P. Rich**, PhD '72, is the author of "Deregulation and Labor Demand: Sources of Pilot Employment Variation, 1979-1985," a graduate research award paper published in *Public Sector Aviation Issues* (Transportation Research Record 1161).

XVIII MATHEMATICS

Stephen H. Crandall, PhD '46, Ford Professor of Engineering and director of the acoustics and vibration laboratory in the Department of Mechanical Engineering, was named an honorary member of the American Society of Mechanical Engineers. He was recognized for "seminal contributions to the understanding of random vibrations, to the education of students in dynamics and mechanics, and for service to the profession." . . . **Frederic Yui Ming Wan**, PhD '65, professor of applied mathematics and associate dean for natural and mathematical sciences in the College of Arts and Sciences at the University of Washington, Seattle, has been named a Fellow of the American Society of Mechanical Engineers. . . . **Robert A. Leonard**, '57, is president of Ticketmaster Corp., "now America's largest ticket company at \$500 million in annual sales," he writes. . . . **Michael E. Hoffman**, PhD '81, has been promoted to associate professor at the U.S. Naval Academy.

XXII NUCLEAR ENGINEERING

Joseph P. Franklin, SM '61, retired from the US army in 1987, and has opened his own consulting

★ Fairer Elections for President ★

An MIT researcher has proved a mathematical theorem supporting his theory that a simple change in the electoral college system could greatly enhance the power of each citizen's vote for president. Moreover, although the proposed change would be minor, he claims it would guarantee the fairest possible election of president and vice president.

Since the late 1960s, Alan Natapoff, a research scientist in MIT's Center for Space Research, has pursued the idea of his "Maximum Voting Power" (MVP) modification to the electoral college. Politicians who listened skeptically to his U.S. Senate subcommittee testimony in the mid-1970s might well wish to take note of the article that Natapoff recently submitted to a professional journal titled, "More Robust Mathematical Voting Power in Presidential Elections through Districting: The Overpowering Refinement Theorem."

"The way we vote for president is a subtle disaster for the 10 million Americans, more or less, who vote in states dominated by one party or the other," says Natapoff. "The disaster is for all these voters—of both parties." He concludes that not a single vote in these states "can make any appreciable difference in the expected final result."

"Give states electoral votes," he

urges, "in proportion to their total popular vote, not in proportion to their census-determined number of congressmen, as the present system does."

With Natapoff's MVP system, each state would receive as electoral votes the sum of its popular vote (e.g., 2,200,001 votes) plus additional "senatorial" votes (approximately 420,000 in 1984), where 436 is the present number of population-based congressional electoral votes. The state in this example would have a total electoral vote of 2,620,001. It would still be "winner-take-all electoral votes" in each state.

A few of the benefits that Natapoff touts for his proposed modification to presidential voting: (1) The leading candidate would be forced to campaign to assure a large turnout, or risk having his or her victory deflated; and (2) voter turnouts would likely increase as dominant-party state voters exercised real national voting power for the first time.

Not long ago, many national political leaders believed that the presidential election process could be perfected by choosing the candidate with the most popular votes nationally. Among the supporters of "direct voting" have been the American Bar Association and the League of Women Voters. The House of Representatives once voted for a direct

voting constitutional amendment, and the Senate came within a handful of votes for doing the same.

But many have come to believe that direct voting would have adverse consequences: an electorate possibly fragmented into many weak political parties and the ignoring of small states by presidential candidates. Natapoff's analysis established a quantitative statistical framework to understand these issues. Unfortunately, his analysis is not easy to understand intuitively, so the mathematically uninitiated must focus on its conclusions.

Natapoff cites evidence that the present electoral college system is already doing a fairly good job of balancing large vs. small states, even without MVP:

■ Winning candidates have always (except in 1888) won a plurality of the raw popular vote, suggesting that the system is fair to the vote-rich large states.

■ Winning candidates have also always (except narrowly in 1960 and 1976) carried at least half of all the states, suggesting that the system is fair to vote-poor small states.

■ The two senatorial electoral votes for each state have been decisive only in 1916, the closest election so far in the electoral vote.—Eugene Mallove, '69. The author is the chief science writer in the MIT News Office. □

company in Madrid, Spain. . . . **Larry R. Foulke**, PhD '67, lists four hats that he is currently wearing: manager of Mathematical Modeling Group for Westinghouse Nuclear Services Division; member of the Industrial Advisory Board of the Institute for Simulation and Training, which is associated with the University of Central Florida; adjunct faculty member, Department of Nuclear Engineering, Penn State; and member of the Technology Accreditation Commission of the Accrediting Board for Engineering & Technology (ABET). . . . **Eduardo Testart**, SM '81, writes that he is "working on fuels development for MTR reactors at the Chilean Commission for Nuclear Energy. The main focus of my research is in preparing the dispersed phase (aluminides, silicides, or oxides) and studying the properties of the final cermet and fuel."

Victor Iannello, ScD '85, and Professor **Neil E. Todreas**, ScD '66, head of the department, won the dual 1987 best paper award both at the National Heat Transfer Conference in Houston in 1987 and at the Thermal Hydraulics Awards Luncheon in Washington last fall. The paper, "Mixed Convection in Parallel Channels with Application to the Liquid Metal Reactor Concept," is based on Iannello's ScD thesis in 1986. . . . From **William R. (Bill) Corcoran**, PhD '71: "I am an executive consultant with TENERA, L.P. The other MIT nuclear engineering graduates with

TENERA are **Joe Turnage**, PhD '72, **Don Ferguson**, PhD '71, and **Paul J. Wood**, ScD '73. Most of my current assignments relate to the corporate nuclear safety review functions of electric power companies. I am still active with the MIT visiting committee, the MIT summer course on nuclear power safety, and the American Nuclear Society."

TPP TECHNOLOGY AND POLICY PROGRAM

William T. McCormick, Jr., PhD '69, chairman and CEO of CMS Energy Corp. and its principal subsidiary, Consumers Power Co., was named by McGraw Hill Co. and its publication *Electrical World* as Outstanding Utility CEO of 1988. . . . "As an energy specialist at the World Bank," writes **Kevin B. Fitzgerald**, SM '86, "I am currently working on biomass and rural energy projects in China, the Philippines, and Indonesia."

From **Carol A. Eberhard**, SM '82: "I have begun a new job at the State Department—with the Bureau of Oceans and International Environmental and Scientific Affairs. I am still working in the field of nuclear nonproliferation, but have broadened my responsibilities to include U.S.-USSR cooperation in nuclear safety matters." . . . **Nicholas A. Ashford**, associate professor of

technology and policy at MIT, has been appointed to the National Advisory Council for Environmental Technology Transfer, a group that advises the administrator of the EPA. . . . **Carmen Teresa Villarreal**, SM '85, is the author of "Uses and Misuses of Risk Metrics in Air Transportation," a graduate research award paper appearing in *Public-Sector Aviation Issues* (Transportation Research Record 1161).

Tony Marra, SM '88, is employed at the Space Systems Division of Booz Allen & Hamilton in Bethesda, Md. He is currently assigned to support the Space Station Chief Scientist at NASA headquarters. . . . **Philip Ng**, SM '85, is living in Hong Kong where he is developing a ferry terminal serving China. . . . **Steven Izatt**, SM '84, has joined the PA Consulting Group in Hightstown, N.J. PA is a major worldwide consulting firm headquartered in London. They consult primarily with Fortune 500 firms whose strategic advantage is tied to technology. . . . **Scott Pace**, SM '82, has been elected to the board of directors of the National Space Society. . . . **William Tsai**, SM '88, has joined the council for Economic Planning and Development for Taiwan. . . . **Yongun Lee**, SM '87, is an assistant to the president of KIA Motors of Seoul, Korea.—Richard de Neufville, '60, chairman, Room E40-353, MIT, Cambridge, Mass. 02139.

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T. von Rosenberg IV, '80
M. Walbaum, '87
D. W. Wood, '76
J. S. Yuan, '63

John E. Ward, 1920-1988

John E. Ward, '43, a founder of the Laboratory for Computer Sciences and former lecturer in electrical engineering, died on December 11 at his home in Lexington, Mass.; he was 68.

After graduation, Ward stayed on at MIT to work on the development of airborne radar, and earned a master's degree in 1947. During his 44 years teaching electrical engineering at MIT, he also served as deputy director of the Electronic Systems Laboratory and drew up technical specifications for cable television systems, including Boston's. He retired in 1987.

Ward was a past captain and honorary life member of the Lexington Minutemen, a scoutmaster, and a fellow of the IEEE. For 45 years he played the banjo at folk dances around New England. □

John L. Summers, 1893-1988

Former MIT tennis and squash coach John L. Summers died of a heart attack at his home in Holliston, Mass., on December 21; he was 95.

A four-time U.S. professional squash champion in the '30s, Jack Summers taught at MIT for 27 years. Arriving from England in 1911 as a tennis player, he quickly picked up the second racquet sport, taught for ten years at the Union Boat Club, and helped form the U.S. Professional Squash Racquets Association in 1930. He also spent several years as the tennis pro at the Longwood Cricket Club.

After retiring from MIT, Summers resumed teaching squash at the Union Club, giving lessons once a week until he was 90. □

Robert J. Holden, 1917-1988

Robert J. Holden, who was associate dean of students from 1962 to 1982, died of lung cancer on December 29 at his home in Natick, Mass.; he was 71.

Holden came to MIT in 1953 as a general secretary of the Technology Christian Association (now the Technology Community Association), and from 1955 to 1960 he was in charge of the program and scheduling of the new Kresge Auditorium and MIT Chapel.

Along with his round-the-clock availability as associate dean, Holden was a member of the Freshman Advisory Coun-

cil, which developed counseling and orientation programs for entering classes. He graduated from Albion College in 1939 and Harvard Divinity School in 1942, was a Navy chaplain in World War II, and minister of the First Congregational Society in New Bedford, Mass., from 1946 to 1953. He served as a director of the Neighborhood House in Cambridge and of the Harvard Cooperative Society. □

Dennis H. Klatt, 1938-1988

Dennis H. Klatt, a senior researcher in speech and hearing science, died at the MIT Medical Center on December 31; he was 50 and lived in Brookline, Mass.

After graduating from Purdue University in 1961 and earning a doctorate in communications sciences from the University of Michigan in 1964, Klatt joined MIT as an assistant professor, becoming a senior research scientist in 1978. He was the author of more than 60 scientific papers and was working on a book at the time of his death.

Klatt received the Silver Medal in Speech Communications from the Acoustical Society of America and the John Price Wetherhill Medal from the Franklin Institute in 1987. For several years he served on the editorial board of the Journal of the Acoustical Society. □

Rockwell Hereford, 1902-1988

Rockwell Hereford, '24, a charter member of the MIT Educational Council who represented the Institute's Admissions Office in Northern California for nearly 40 years, died in Monterey on November 26. He was 86.

Hereford was named to the Educational Council when it was founded in 1953, when he was living and working in San Francisco. He continued to represent MIT in Carmel following his retirement in 1967. Given a George B. Morgan Award in 1984, Hereford was cited for 30 years of "representing MIT in the finest possible manner." He was also active in fundraising and was made vice-president of his class in 1969.

Hereford joined the Southern California Edison Co. upon graduating from MIT in Course XV. He soon moved into the field of investments and later made his career in administration and editing for U.S. Steel

Corp., San Francisco. He was vice-president of the International Congress of Industrial Editors when he retired, and subsequently wrote a biography of Henry Robinson, founder of the Huntington Library, for whom he provided investment counsel. □

Deceased

The following deaths have been reported to the Alumni Association since the *Review's* last deadline:

Berthoud C. Boulton, '16; August 23, 1988; St. Louis, Mo.
Lauriston E. Knowlton, '16; December 16, 1988; Houston, Tex.
Isidor Richmond, '16; November 3, 1988; Chestnut Hill, Mass.
Elizabeth T. Barriger, '21; June 22, 1988.
John C. Mahoney, '21; February 24, 1988; Westfield, N.J.
Charles E. Breitbeil, '22; January 15, 1988; Louisville, Ky.
Raymond F. Mann, '22; September 27, 1988; Getzville, N.Y.
Newton B. Schott, '22; December 4, 1988; Montclair, N.J.
Charles B. Schureman, '22; September 1, 1988; Green Valley, Ill.
Stanley B. Black, '23; March 28, 1987; Winchester, Mass.
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ALLAN J. GOTTLIEB, '67

Can You Keep the Peace Among 12 Golfers?

It has been a year since I specified the size of the backlogs for the various kinds of problems that are printed. Let me do so now.

I have close to a year's supply of regular, chess, bridge, and speed problems but have run out of computer-related problems, one of which would otherwise appear as the first problem this month. This may well be a case of the market speaking. If no computer-related problems arrive when their turn comes up again in three issues, I will drop that class and return to alternating bridge and chess problems for problem 1.

Problems

APR 1. Our first problem, from Nob. Yoshigahara, involves multiplying a "time expression," i.e., one involving hours, minutes, and seconds, by a scalar to obtain another time expression. Another requirement is that all ten digits are to be used once each.
 $ab:cd \times e = f:gh:ij$.

APR 2. William Pulver knows 12 golfers who play weekly in 3 foursomes, 2 players as a team in each foursome competing against the other pair in that foursome. The problem is to arrange a schedule so that each golfer plays with each of the other eleven the same number of times and against each of the eleven the same number of times.

APR 3. Matt Stenzel wants you to show that for $p = 2, 3, 4, \dots$

$$\sum_{n=1}^{\infty} \frac{n}{p^{n+1}}$$

is a perfect square.

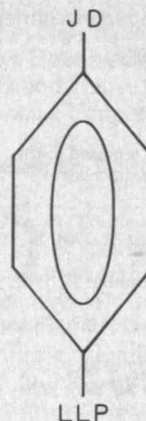
APR 4. Gordon Rice would like you to find non-equilateral triangles containing a 60° angle, all of whose sides are integers. How about 30° ?



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO
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Speed Department

SD 1. Jim Landau wonders what the following chemical formula represents.



SD 2. Warren Himmelberger is interested in wives of U.S. presidents and wants you to identify Anne I, Claudia I, Thelma I, Sarah II, and Dorothea I.

Solutions

N/D 1. Gordon Rice reminds us that a number in a particular number base is *palindromic* if the digits (leading zeros excluded) read the same right-to-left as left-to-right. For each integer $N > 2$ let $P(N)$ be the least integer exceeding $2N$ that is palindromic both in base N and in base 2. What is the smallest N such that $P(N) > P(3)$?

David Simen writes that "this is a good problem for the C programming language, which handles numerical computations and string manipulation with equal ease." Mr. Simen attached a C program, which is available from the editor, to solve the problem. The program reveals that $P(3) = 6643$, which is not exceeded until $P(41) = 7671$.

Also solved by Richard Hess, Matthew Fountain, Jerry Grossman, and the proposer.

N/D 2. You encounter three people who know each other. One always tells the truth; one lies all the time; and one gives random answers. How can you tell, by asking only three questions directed to only one person at a time, which is which?

Rather surprisingly, Andrew Marshall appears to be able to solve this problem asking only two questions (chosen from a set of three questions). His solution follows:

If the second question is based on the answer to the first question, then the solution can be arrived at with just two questions. First, label the individuals A, B, and C. For the first question, ask A, "Would B say that $1 = 1$?" (or any obviously true statement). If the answer is "No," then the second question (addressed to B) would be, "Would C say that you (B) would say that $1 = 1$?" If, on the other hand, the answer to question 1 is anything else, then the alternative second question (addressed to C) would be, "Would A say that $1 = 1$?" It is essential that

there are four possible answers to each question—Yes (= Y), No (= N), I don't know (= ?), and I know (= !), which is the falsification of "I don't know." The following table gives the meaning of each pair of answers.

A	B	C	Q1	Q2	Q2A
True	False	Random	N	!	
False	True	Random	N	?	
Random	True	False	N	N	
Random	False	True	N	Y	
True	Random	False	?		N
False	Random	True	!		N
Random	True	False	Y or ? or !	!	
Random	False	True	Y or ? or !	?	

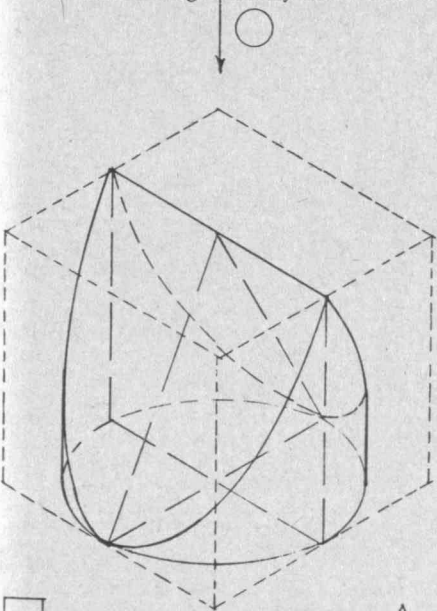
Any answer not noted is impossible. It may appear that question 2 is more complex than necessary, but the simpler question to B, "Would C say that 1 = 1?" would be unable to distinguish between *Random True False*, and *Random False True*.

Also solved by Larry Bell, Robert Bart, Gordon Rice, and Matthew Fountain.

N/D 3. Find a single shape that will fit snugly through all three holes in the board shown below. Each edge of the square is the same length as the diameter of the circle and as the bottom edge of the triangle. You are free to specify the other two edges of the triangle as part of your solution.



Walter Cluett notes that the answer is a shape, fitting within the outlines of a cube, that is a circle when viewed from the top, a square from the front, and a triangle from the side. The height of the triangle equals the base of the triangle. Mr. Cluett also enclosed the following beautifully drawn solution:



Norman Spencer and Alan Stiehl sent in wood models they produced in their home shops. These two models, which are about the same size, now have honored locations atop my computer display. Joe Alfano found this problem mentioned in Martin Gardner's August 1958 column in *Scientific American*.

Also solved by Robert Bart, Richard Hess, Winslow Hartford, Larry Bell, Harry Zaremba, Ken Rosato, Matthew Fountain, Charles Sutton, and the proposers, Gary Schmidt and Joe Horton.

N/D 4. In how many ways can the integers from 1

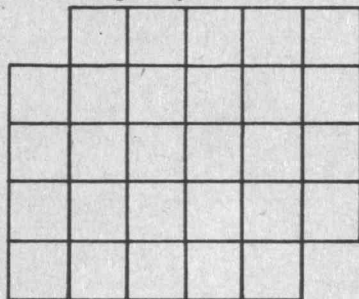
to N be permuted so that the result consists of a strictly ascending sequence followed by a strictly descending sequence? For example, with $N = 9$ we could have, 1, 4, 5, 7, 9, 8, 6, 3, 2. [These sequences are sometimes called *bitonic*—ed.]

Gordon Rice responds that the answer is 2^{N-1} and adds that "this is really a question about subsets, not permutations. Once we choose a set of numbers which form the ascending part of the sequence, everything else is determined. The number of distinct subsets of N things is 2^N . The reason that our answer is half of this is that we don't include N itself in the subset. The position of N is always between the ascending and descending parts of the sequence, and need not be thought of as a part of either. If the monotonic sequences 1, 2, ..., N and $N, ..., 2, 1$ are not accepted as degenerate cases of bitonic sequences, subtract 2 from the answer."

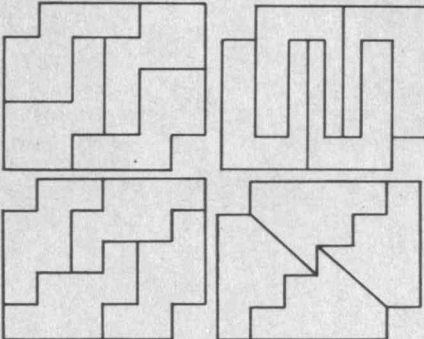
Jerry Grossman reports that this problem "as well as thousands more" will appear in his undergraduate discrete mathematics text to be published by Macmillan next year.

Also solved by Joe Alfano, Robert Bart, Jerry Grossman, Richard Hess, Winslow Hartford, Harry Zaremba, Walter Nissen, Larry Bell, Steven Feldman, David Simen, Matthew Fountain, Charles Sutton, and the proposer, Frank Rubin.

N/D 5. Find four ways to divide the figure below into four congruent pieces.



Nob. Yoshigahara, a frequent contributor of problems for this column, sent us his first solution:



Gordon Rice found several solutions where an individual piece was a non-connected region.

Also solved by Matthew Fountain, Richard Hess, Harry Zaremba, and the proposer, Solomon Golomb, in whose *Johns Hopkins Magazine* column the problem first appeared.

Better Late Than Never

1988 A/S 3. Alan Prince sent us a more direct solution to this problem by writing $\tan(80^\circ)\tan(40^\circ)\tan(20^\circ) = \tan(60^\circ + 20^\circ)\tan(60^\circ - 20^\circ)\tan(20^\circ)$, applying the double angle formula, and noticing that the result fits the formula for $\tan(3x)$ with $x = 20^\circ$.

Proposers' Solutions to Speed Problems

SD 1. Paralegals.

SD 2. Nancy Reagan, Lady Bird Johnson, Pat Nixon, Jane Wyman (first wife of Ronald Reagan), and Dolley Madison.

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Splitting an embryo resulted in these completely normal, identical calves.



PHOTO: COLORADO STATE UNIVERSITY

Geneticists in the Pasture

BY GEORGE E. SEIDEL, JR.

Although some new methods for breeding farm animals sound like science fiction, they simply build on biotechnologies already in use.

POPULAR articles about biotechnology tend to focus on its effects on humans and crops. Yet one of the biggest impacts will be on animal agriculture. In the next several years we can expect to see animals with genes from other species, offspring from either two female or two male parents, and animal clones numbering in the thousands. These creatures will resist diseases better, reproduce more efficiently, grow faster, and yield higher-quality products. Exotic as the methods sound, they will evolve from breeding practices that already have had dramatic benefits. For centuries farmers have used simple selection techniques to produce animals that differ greatly in size, food-production characteristics, and docility. In recent decades they have turned to biotechnology to improve upon the process. For example,

In two to four years, scientists could improve farm animals by changing genes in embryos.



artificial insemination, which became widespread about 35 years ago, has allowed U.S. farmers to produce more milk with 10 million cows than they did in 1945 with 25 million.

Most of the new methods will simply speed up the pace of genetic changes. While many critics question the impacts, the technologies likely will be environmentally sounder than current practices, and probably will enhance animal health. Food prices will continue to drop, although some farms and agribusinesses that cannot keep up with the changes will die out.

Most of the procedures are now being used on cattle, since they are too expensive to use on species such as sheep that bring in lower income per animal. But this will change as the industry becomes more experienced with the techniques and prices drop.

GEORGE E. SEIDEL, JR., professor of physiology at Colorado State University, received his doctorate in reproductive physiology at Cornell University and did postdoctoral work at Harvard Medical School. He is conducting research funded by private industry on disease-resistant transgenic animals, and developed a commercial venture owned by his university that collects, freezes, splits, and transfers embryos. Seidel was raised on a dairy farm in Pennsylvania.

Mosquito Genes in Farm Animals

A new biotechnology procedure that could become commercially available in as little as two to four years is "transgenesis," which permits scientists to create an animal with specific traits by adding, removing, inactivating, or repairing genes in an embryo. The additional genes can come from any source. For example, if a gene of interest occurs in mosquitoes or alligators—say, one that codes for resistance to a certain disease—it can be removed and placed in the embryo of a farm animal. The several strains of commercially useful transgenic farm animals that will probably emerge in the next few years could include leaner pigs, poultry resistant to avian influenza and other deadly diseases, sheep with wool that is easier to wash, and goats that produce valuable pharmaceuticals in their milk.

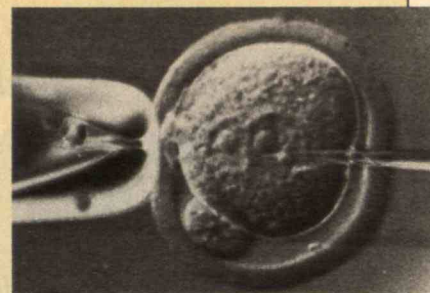
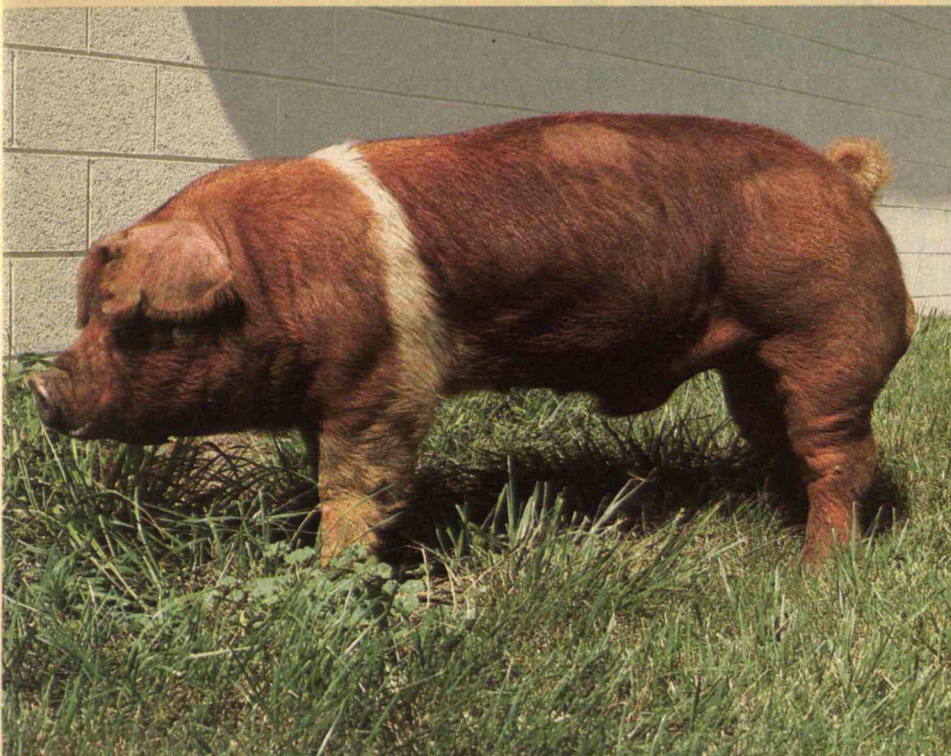
The simplest way to make transgenic animals is to inject a gene into a one-cell embryo and then implant the embryo in another animal. Under the right conditions, the new gene joins one of the embryo's strands of genes. Each cell created as the embryo divides gets a copy of the new gene.

An alternative technique is to in-

corporate the gene into a type of virus known as a retrovirus that has been modified so it cannot reproduce itself after entering a cell. The virus, which cannot cause disease, delivers the gene to the cell's nucleus. Often this method is better than gene injection because a retrovirus always delivers just one gene, and the gene is always intact.

Yet another method is to add genes to undifferentiated embryonic cells, which are then placed in other embryos. But so far the difficulty of keeping the embryonic cells of farm animals from differentiating into various specialized cells has made it impossible to use this technique with these species.

An interesting use of transgenic technology relies on the gene responsible for producing casein, the major protein in milk. Like almost all genes, this one has a part that is structural: it carries the information needed to create the protein. Another part is regulatory: it determines when and in which cells casein is made—in mammary tissue and only during lactation. Joining the regulatory part of the casein gene with the structural part of genes that code for valuable pharmaceutical products can result in a



Far left: One of the first transgenic mammals, reported in 1982, was produced when a gene for growth hormone was injected into a single-cell mouse embryo. The resulting animal was twice as large as a typical mouse. Near left: This pig, which also received a gene for growth hormone, is no larger than normal. But it has only about a fifth the usual amount of fat. Above: Copies of genes are injected into a fertilized egg with the aid of the pipette on the right. On the left a large pipette steadies the egg.

farm animal whose milk contains medicines such as tPA—which dissolves blood clots after heart attacks—and human blood-clotting Factor IX—which hemophiliacs use.

Another technique that should become commercially available in the next decade is the transplantation of cellular nuclei. It could yield thousands of identical offspring. In many cases this offers clear advantages over sexual reproduction, which produces unpredictable results.

The technology is based on the fact that the nucleus of every undifferentiated cell in a single embryo contains the same genetic information. With this in mind, animal scientists can transplant the nucleus from each cell of a 32-cell embryo into 32 single-cell eggs whose original genetic information has been removed by suction using microsurgical methods. The nuclei and eggs are usually fused through a pulse of electrical current. If 10 percent of the eggs survive (the rate ranges from 0 to 30 percent), the result is 3 embryos, which then are allowed to develop to the 32-cell stage. The 96 identical nuclei from these 3 embryos can be transplanted to 96 single-cell eggs. With a 10 percent survival rate each time, repeating the pro-

cedure should yield approximately 9 embryos, then 28, 89, 284, and so on.

When enough embryos accumulate, some are transferred to animals for gestation. If the offspring are determined to be of superior quality, the remainder of the embryos, which have been frozen, are saved.

In the short time that scientists have worked with this procedure—the first article concerning its use with farm animals was published in 1986—they have obtained up to seven cloned calves from one embryo. As researchers continue to work with species other than laboratory animals in the next few years, success rates are likely to increase.

Still another biotechnology that is developing rapidly for farm animals is in vitro fertilization (IVF), which involves extracting an egg and sperm from animals and mixing them in a test tube to form an embryo. The embryo is then placed in another animal's reproductive tract to develop. Today this technique is much more widely used with humans than farm animals.

For animal agriculture an important advantage of IVF is that the eggs are very inexpensive, since they are collected at slaughterhouses. More-

over, in the future animal scientists may be able to save and use tens of thousands of eggs from each ovary.

IVF research will soon receive a huge infusion of resources because the number of cows in Europe has recently decreased, which has resulted in markedly higher beef prices. A neat solution to the demand for more animals is to have a high proportion of cows produce twins. This could be accomplished by fertilizing eggs in test tubes and then placing two embryos into each cow's reproductive tract.

Virgin Births

Two more exotic techniques show longer term promise, perhaps early in the next century. They are gynogenesis, in which an offspring is produced with only female parents, and androgenesis, in which two males are used to produce offspring. Androgenesis would be particularly valuable, since artificial insemination has revealed the genetic qualities of bulls with great precision. Superior offspring would be obtained by crossing two high-quality bulls rather than a superior bull with a female whose quality is uncertain.

Androgenesis exploits the egg's

Researchers have bred poultry, fish, and amphibians from parents of the same sex, although not for commercial purposes.

function as a processing device for sperm. The trick is to fertilize it with two sperm. A block that prevents a second sperm from entering the egg normally occurs upon fertilization, but scientists can cover an egg with so many sperm that two can enter simultaneously. Next researchers remove the egg's genetic material through suction. The genetic material from the two sperm then combines as that from one sperm and an egg normally would.

With gynogenesis, scientists fuse two eggs to start embryonic development. Electrical pulses are often used to join the eggs. Inactivated viruses can also do the job by breaking down the eggs' surfaces.

So far, poultry, fish, and amphibians have been produced by gynogenesis and androgenesis, although not for commercial purposes. In some high school biology classes students even produce frogs by a form of gynogenesis called parthenogenesis, which is Greek for virgin birth. This technique involves stimulating an egg so that two doses of genetic information from it join together.

These procedures are difficult to perform with mammals because their genetic material appears to change subtly as it passes through testes and ovaries. The subtle changes are complementary: both sexes are needed to develop an adequate placenta, blood supply, and fetus. Thus, mammalian gynogenetic embryos die after reaching a size of thousands of cells, while androgenetic embryos die even earlier.

At present, androgenetic embryos are difficult to save. It is possible, however, to rescue the gynogenetic embryos of mammals by mixing their cells with those of normal embryos, which already have a good placenta and blood supply. These embryos end up containing both normal and gynogenetic cells. Sometimes the resulting offspring can produce eggs containing genes from the animals used in gynogenesis, so that traits from valuable

females can be passed on.

Today, nearly all experimental work in this field is done with mice, which may present more severe technical problems than farm animals. But it is virtually impossible to obtain funding for similar research on farm animals because the costs are so high.

A Stallion from a Rival's Camp

The new biotechnologies are evolving from older breeding procedures. One of these, artificial insemination, may have first been used in horses centuries ago. Anecdotal evidence suggests that an Arab sheik arranged for his rival's powerful stallion to breed with a mare whose vagina contained a cloth pessary. The pessary, drenched with semen, was sneaked out of the rival's camp and placed in the vagina of a favorite mare, who became pregnant. Artificial insemination came into heavy use with dairy cattle in North America in the late 1940s, and today about 70 percent of the 10 million dairy cattle in the United States become pregnant by this means.

Artificial insemination is important because the process allows the semen from the best bulls to be identified so that it can be used repeatedly. These bulls can have tens of thousands of offspring each year if their semen is regularly collected and frozen.

The technique also has indirect benefits. Because of efforts to control disease in bull studs and the antibiotics that are added to their semen, cattle produced by artificial insemination rarely have venereal disease. In addition, small farmers find artificial insemination economical because the costs run just \$10 per breeding, and facilities and feed are not needed for bulls. The practice is also much safer than keeping dairy bulls, which each year kill and maim more Americans than all other animals combined.

Nevertheless, artificial insemination is used for less than 5 percent of the 32 million beef cows in the United

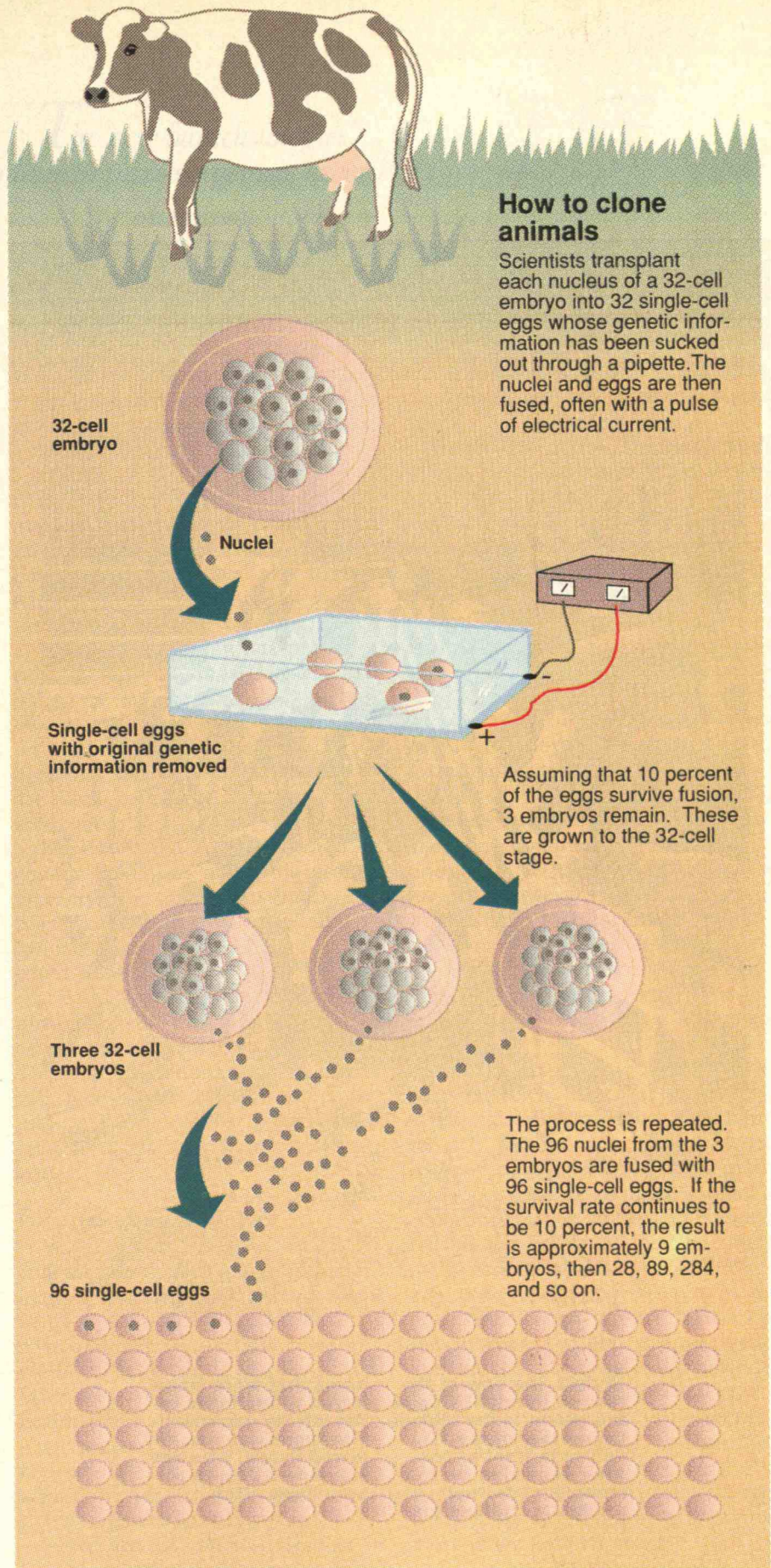
States. In part this is because of problems with confining cows on the range. It is also difficult to detect the days when such animals are fertile. If animals fail to become pregnant in a breeding cycle, farmers' profits decrease greatly, since they cannot offset feed and other maintenance costs.

Artificial insemination is even more uncommon with swine, sheep, goats, and horses. However, it is employed extensively for poultry. In fact, the technique is necessary for the bulk of U.S. turkeys, since they are of strains selected for so much breast meat that the males cannot get close enough to the females to mate reliably.

Another well-established breeding method is embryo-transfer technology. With this method, a valuable cow is inseminated, and a week later a technician recovers the embryo by irrigating the uterus. Then the embryo is placed in the uterus of a less valued cow, who carries the pregnancy to term. This leaves the high-quality animal free for rebreeding in later reproductive cycles, which occur every three weeks. Typically, yields are boosted by injecting the valuable cows with hormones known as gonadotropins. These stimulate the ovary to produce about six normal eggs per cycle, a process that on average results in three to four calves.

Commercial use of embryo transfer began about 15 years ago, and today 100,000 calves are produced annually by this means in the United States and Canada. Although sheep, goats, pigs, and horses are also produced through embryo transfer, the procedure is so complex and costly that cattle constitute more than 95 percent of the commercial use.

Embryo transfer has proven important for circumventing certain types of infertility, such as that in older cows. In addition, the technology is used to transport genetic material among countries, since embryos carry fewer diseases than semen or animals. The costs are lower than those for trans-



porting animals as well.

Like semen, embryos can be frozen and used later. Although the pregnancy rate in cows drops about 15 percent with frozen embryos, farmers do not have to pay maintenance costs for their animals while they wait for embryos. And calves from frozen embryos are completely normal. Researchers in England have shown that with proper precautions, embryos (and semen) probably could be stored for several millenia in liquid nitrogen without noticeable genetic damage.

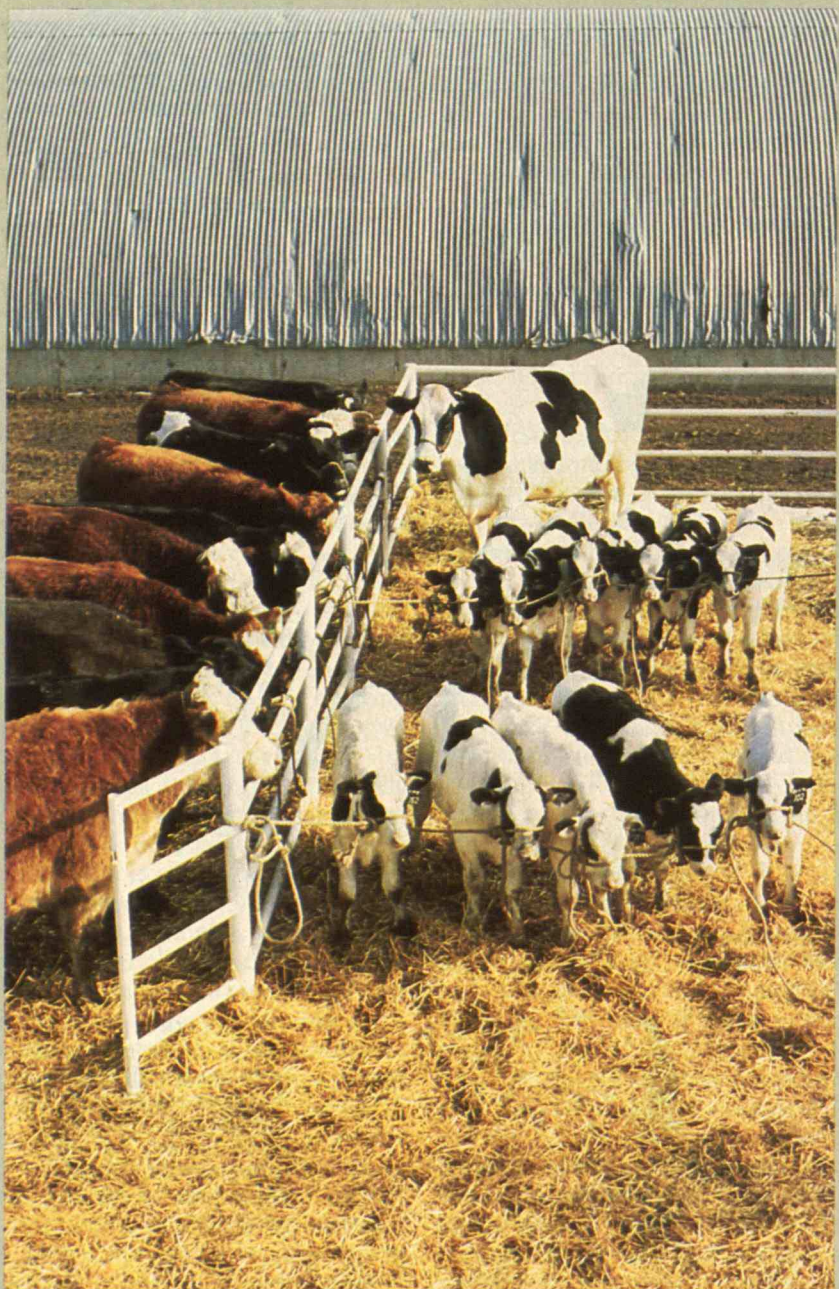
One other breeding technology, bisection of embryos, has been used for the past eight years. Today several thousand calves are produced annually by dividing multi-celled embryos into two parts with a fine glass needle or fragment of a broken razor blade. Pregnancy rates per half embryo are on the order of 50 percent. But since there are two halves, over the long run an average of one offspring per pair is produced. That is better than the 60 to 70 percent success rate for whole embryos nurtured under top commercial conditions. The calves resulting from bisected embryos are identical twins and appear to be completely normal.

Who Will Benefit?

Despite the excitement over the scientific research and the possibility of improving traits, the new breeding technologies raise a host of important economic, environmental, and animal-welfare concerns. Some observers also question the ethics of patenting animals created by these means.

The economic benefits for consumers will be significant. Buyers will see a greater variety of food and fewer food-borne diseases. Even more important, the improved animals will produce larger supplies of food, which will lower prices, since demand for food is relatively inelastic.

Indeed, because dairy farmers have produced milk more efficiently in the



Sylvia, the cow at the rear on the right side of the fence, is the biological mother of the 10 calves in front of her. After receiving the hormone gonadotropin, she produced multiple em-

bryos that were transferred to the cows on the left for gestation. The technique has allowed Sylvia, who has valuable traits, to be bred more often.

last 10 years, it now costs less in constant dollars. And over the past dozen years per-pound prices for beef cattle have dropped by nearly half in constant dollars.

But while the outlook for consumers is good, some farmers will fall victim to the new breeding methods. Although those who adopt any new agricultural technology early on benefit temporarily, profits drop as other farmers follow suit to remain competitive. Also, since new technologies usually lead to more complex farming operations and require more education, some farmers are left behind. The net effect is fewer farms with fewer total animals.

Artificial insemination has contributed to the decrease in commercial dairy farmers from about 1.5 million in 1945 to less than 200,000 today. And within several years, the use of another new technology—bovine growth hormone—to increase milk production may reduce the number of dairy cows by more than 10 percent. This could translate into 15 percent fewer dairy farms, perhaps 30,000. Nearly all would be family farms.

Despite this unfortunate effect, technological advances are critical for American farming as a whole. Since consumers want to pay as little as possible, food imports will rise if U.S. farmers can't offer prices comparable to those of overseas competitors. Many dairy imports from New Zealand, for example, are cheaper than similar products from American farms. Although in this case quotas now protect U.S. farmers somewhat, the United States should not have to rely on restrictive trade policies, which can result in reciprocal measures by other countries. Such actions lower the standard of living for the population as a whole.

The new biotechnologies will also affect employees in the farm-supply and food-processing, transportation, and marketing industries. Nearly 20 percent of all U.S. jobs fall within this

The new biotechnologies could help increase genetic diversity.

group, compared with the 2 percent who work as farmers.

Observers commonly think that the largest biotechnology companies will automatically benefit from the new breeding methods while all small suppliers will be hurt because of a decrease in farms. It is true that hard times on farms have been devastating to rural towns with businesses that work closely with farmers. And there might be a concentration of biotechnology companies in the future. But not all small businesses will necessarily suffer; changes also create opportunities. For instance, some small businesses and veterinarians are thriving by providing embryo-transfer services to farmers.

Sound Environmental Underpinnings

Fortunately, most of the new methods are more environmentally sound than those they replace. For example, since fewer animals will be needed, less farm runoff will pollute streams and rivers.

A major concern is the possible release of genetically engineered organisms that could become pests or cause disease or other problems. But farm animals are unlikely to escape and thrive in the wild. After all, they cannot survive as well as their ancestors did before domestication.

Environmentalists also wonder whether the new breeding techniques will further reduce the genetic diversity of animals. If that occurred, a disease affecting a popular strain could quickly wipe out a large percentage of animals.

While on the whole the genetic diversity of plants and animals in U.S. agriculture is lower than it was early this century, the variety of beef cattle has increased greatly. For most of the 1900s, the vast majority of U.S. beef cattle were Angus or Hereford, with Shorthorns running a distant third. All three breeds are fairly similar genetically. Today there are a dozen im-

portant breeds. This is because farmers rely on bulls that produce the best animals for their local environments. Since artificial insemination and embryo-transfer techniques frequently are used to produce breeding bulls, these biotechnologies have had a role in increasing this diversity.

In contrast, the genetic diversity of U.S. dairy cattle has decreased so much that today nearly 90 percent of these animals are Holsteins. Yet the genetic variety is actually higher within Holstein herds than it was in the days of natural breeding. Once again, biotechnology has played a role. In the past, most farmers had only one bull or shared one with neighbors, but now the wide use of artificial insemination has reduced inbreeding. As a result, individual herds are less susceptible to disease and generally more robust.

The new biotechnologies could be equally helpful in increasing genetic diversity. The millions of frozen embryos and doses of semen already available from many different breeds could accomplish this task. Toward that end, it would help if the government invested a few million dollars to set up central gene banks for semen. There are no national entities of this sort today. Indeed, much stored semen is kept only for sentimental reasons or because it has been forgotten.

Protecting Animal Welfare

Will the new techniques mean that animals will suffer? Domestication implies a contract to take care of animals' needs. As new breeding methods take hold, emphasis will likely increase on improving animals' health. After all, healthy, well-fed animals are more profitable than malnourished, sickly ones, despite what advertisements from certain animal rights' organizations imply.

There are, of course, instances in which animals' well-being conflicts

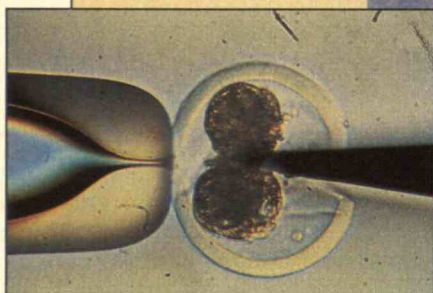
with farmers' profits. For example, laying hens typically are greatly restricted in their space. But as has been done with household dogs, farm animals can be selected that are healthy and productive in specific environments.

Moreover, people's ideas about what is best for animals often do not correspond to reality. For example, several decades ago when I was a youngster on a dairy farm, my parents kept our calves warm in barns in winter. Since then, research has shown repeatedly that calves thrive in cold weather. Keeping calves in individual hutches at outside temperatures leads to healthier, faster growth because of better ventilation, lower humidity, and decreased risk of spreading disease.

Granted, the new biotechnologies sometimes include procedures such as injections, confinements for short periods, and, on rare occasions, minor surgery. However, medical advances will decrease such incidents. And living animals will be used less often as, for example, scientists develop ways to conduct in vitro fertilization on eggs from cows sent to slaughterhouses.

Another possible problem concerns cases in which unnatural animals are produced. Of course, mules and, more recently, beefalo, have been produced without biotechnology. While many crosses are sterile or have problems during pregnancy, there is no evidence that these animals are worse off than their parent species. And although transgenesis sometimes results in abnormalities, most serious defects kill the embryos. Any impaired transgenic animals that survive usually have defects such as arthritis that render them commercially unprofitable—incapable of growing, milking, or reproducing as well as normal animals. Arthritic animals in particular are typically culled early because they require more labor to move around.

As for any abnormal animals that



Above: Bisecting an embryo with a micro-surgical blade can double the number of offspring. **Right:** Question and Answer are identical foals produced from a bisected embryo.



result from research, scientists should be sensitive to their problems. When an animal suffers from pain, researchers should give analgesics or, if necessary, kill it in a manner that does not cause discomfort. But despite the unfortunate accidents that might happen during experimentation, the overall result of biotechnology will probably be reduced animal suffering and disease.

The Patenting Brouhaha

Last year, for the first time, the U.S. Patent Office granted a patent on an animal: a transgenic mouse developed at Harvard Medical School. Now the government is considering numerous patents on animals. Many people and organizations oppose such patenting, believing that it will enable the major

Continued on page 52

Hughes Aircraft Company was the recipient of the U.S. Army Award for outstanding achievements in Value Engineering for cost-savings. In 1987, Hughes Value Engineering Change Proposals (VECPs) saved customers over 53 million dollars. Since 1964, 735 Hughes VECPs on 53 programs have resulted in a total savings of 1.136 billion dollars. Some of the programs benefitting from the VECPs include F/A-18 avionics, Maverick, Phoenix, and Advanced Medium Range Air-to-Air Missiles, M1 Abrams Tank, Bradley Fighting Vehicle, and the AN/UYQ-21.

A new Space Based Radar Program will involve the placement of a constellation of sensor platforms in the Earth's orbit between 600 and 6,000 nautical miles in altitude for wide area surveillance of ships, aircraft, and cruise missiles. Hughes, as a member of the Grumman-led team, will define technology requirements and an implementation plan for the radar RF and processing sections, which will interface with Grumman's SBR system. An operational demonstration-validation phase will lead to a first launch in the mid-1990's. The Space Based Radar Program is a joint U.S. Air Force and Navy program.

An infrared sensor system for the joint services' V-22 Osprey aircraft will help crews navigate and land in darkness and during periods of poor visibility. The Infrared Detection Set (IDS), developed by Hughes, senses small differences in radiated heat and provides a TV-like image of the surrounding area. The V-22, the first of the new tilt-rotor aircraft for the U.S. Armed Forces, is able to take off and land like a helicopter, but fly like a plane. Hughes will start flight testing the IDS in early 1989, with flight test support continuing through 1991.

A weather satellite in geosynchronous orbit above the Atlantic seaboard "sees" cloud cover even at night. The Geostationary Operational Environmental Satellite (GOES) H, built by Hughes, sees through a combination telescope and sensing instrument called a visible-infrared spin scan radiometer atmospheric sounder (VAS). Developed by Hughes, the VAS uses reflected visible light and infrared thermal radiation to gather images of Earth and its atmosphere. The last in a series of five weather satellites, GOES H watches for storms that threaten the East coast.

Hughes Missile Systems Group is advancing every phase of research and development, as it applies to tactical guided missile systems and strategic defense. Opportunities for engineers and scientists are in analog/digital circuit design; high-voltage power supply design; electro-optical design; IR imaging sensors; focal plane arrays; and systems engineering. Send resume to Hughes Engineering Employment, Dept. S2, 8433 Fallbrook Ave., Canoga Park, CA 91304. Equal opportunity employer. U.S. citizenship may be required.

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HUGHES

*It seems
arbitrary to
oppose animal patents
since equivalent
laws for plants
have existed
for years.*

biotechnology companies to control animal husbandry. They worry that those farmers who cannot pay for the improved animals will be hurt as other farmers increase their profits through patented animals.

It is true that a concentration of patent holders might occur, and that some animals probably will sell at higher prices than they do today. However, in most cases farmers will be able to afford the superior animals. After the technology becomes commonplace it would be surprising if fees for semen—which probably will be sold more often than patented animals themselves—rise more than \$5 per dose, for example. It makes sense for

patent holders to promote the use of their licenses widely by not charging excessively.

Nevertheless, some farmers will lose out because they won't be able to maintain profits as the technologies become popular. Still, it would be arbitrary to exclude animals from being

patented. Equivalent patent laws for new varieties of plants have existed for years.

In addition, the need for patents is limited because the original patent owner will control the world's supply of a transgenic animal. And even without patents, owners could write business contracts that specify compensation for transgenic animals that are sold and that produce later generations.

The seed-corn industry provides an excellent example of an alternative way to protect an investment. The industry sells only hybrid corn, which is made from crossing strains. This corn grows well but does not produce use-

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ful offspring. Therefore farmers must buy seed for each crop. Procedures to make outstanding animals that do not reproduce reliably are being considered for similar reasons. In the past decade federal funds for farm-animal research have declined markedly in constant dollars, and private industry will have to take up the burden.

Finally, the brouhaha over animal patenting appears excessive because many patent claims, if challenged, probably will be too broad for patent holders to enforce in the courts. For instance, because of prior genetic research, many observers believe that some claims for the Harvard mouse will not hold up.

*Although
biotechnology carries
a risk, the danger of
restricting innovative
techniques
is greater.*

Despite the fact that the new breeding methods do not pose unwarranted problems, society must look carefully at the ratio between the overall costs and benefits for each biotechnology. Consider an example from plant agriculture. In 1969 and 1970, Southern leaf blight wiped out 15 percent of the

hybrid corn crop, because a set of genes used to produce that corn seed also made it susceptible to disease. In the end, this costly mistake—which observers have estimated had a \$1 billion economic impact—was small compared with the benefits of hybrid corn. Since the advance was introduced in the 1930s, it has enabled corn production per acre to more than double.

Although biotechnology carries a risk, restricting innovative techniques too much is a bigger risk. Because of the possibilities for less expensive, more varied, and safer products, it would be wrong not to use biotechnology when appropriate. ■

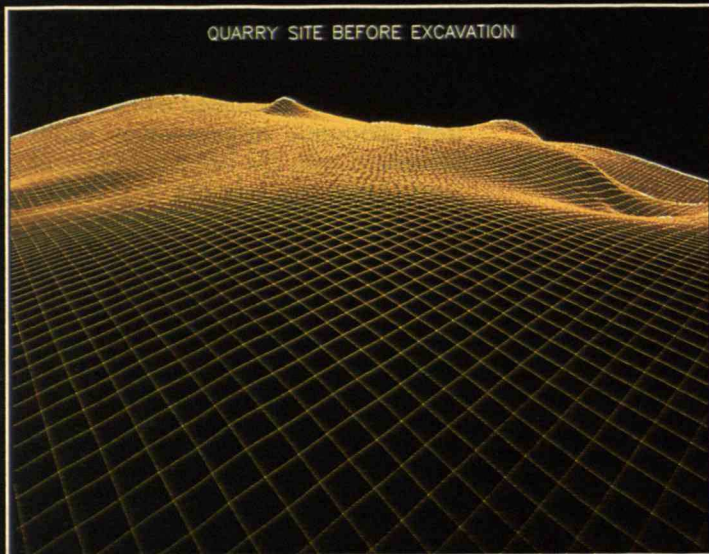


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QUARRY SITE BEFORE EXCAVATION



QUARRY SITE AFTER YEAR ONE



The Electronic Transformation of

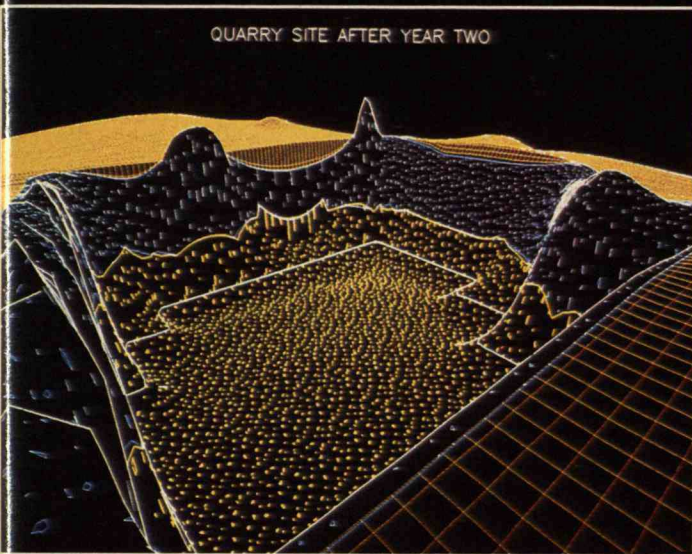
M

A study of Geneva, Ill., tested the value of computer mapping in town planning. The system produced these photos to predict what a proposed quarry site might look like from one year to the next.

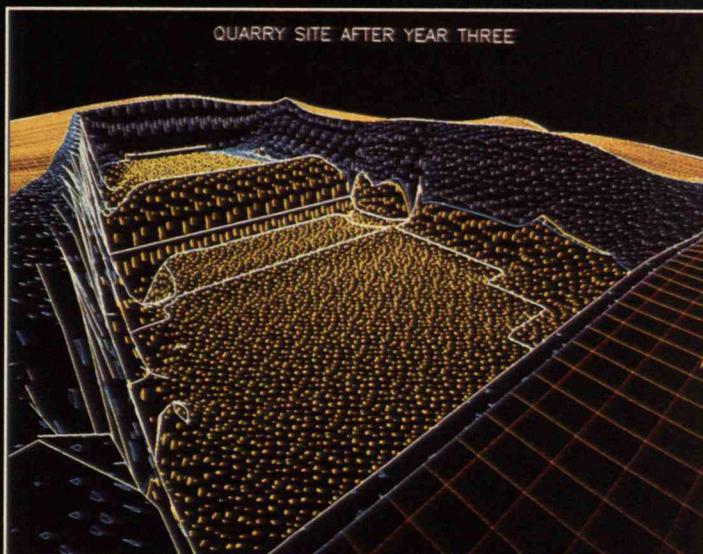
CARTOGRAPHY is in the midst of a revolution. For centuries maps have embodied all our concepts of spatial relatedness. Now a data explosion has forced researchers to reevaluate and remake these tools. At the heart of the revolution is the computer.

When information was scarce, traditional maps served their purposes well. But aerial photography and satellite remote sensing are creating a wealth of data, as are the national census, natural-resource inventories, environmental-impact studies, and public-administration surveys.

QUARRY SITE AFTER YEAR TWO



QUARRY SITE AFTER YEAR THREE



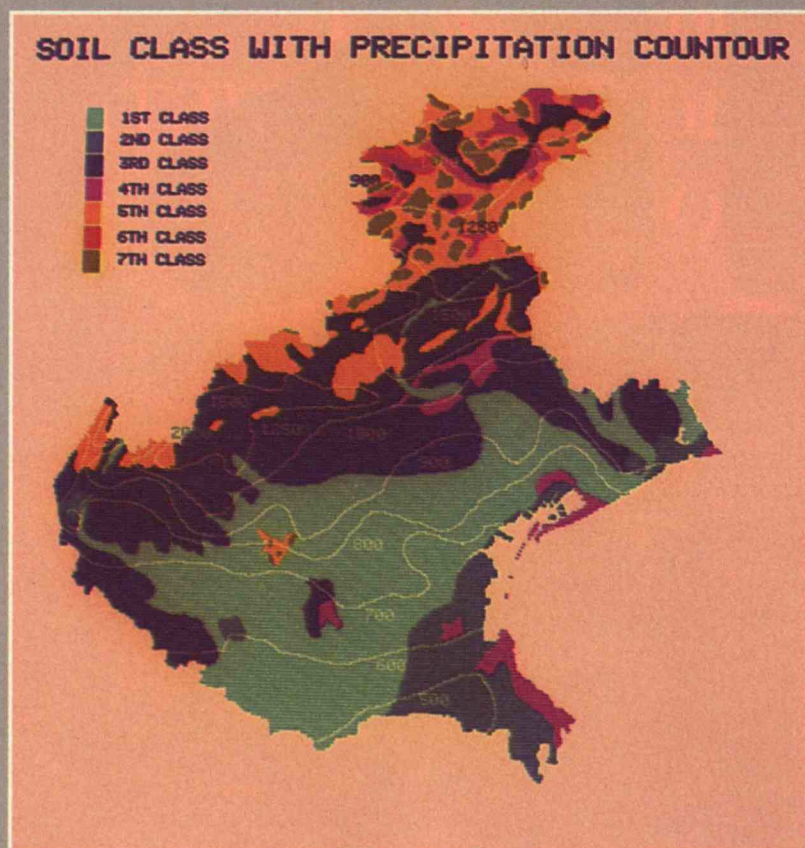
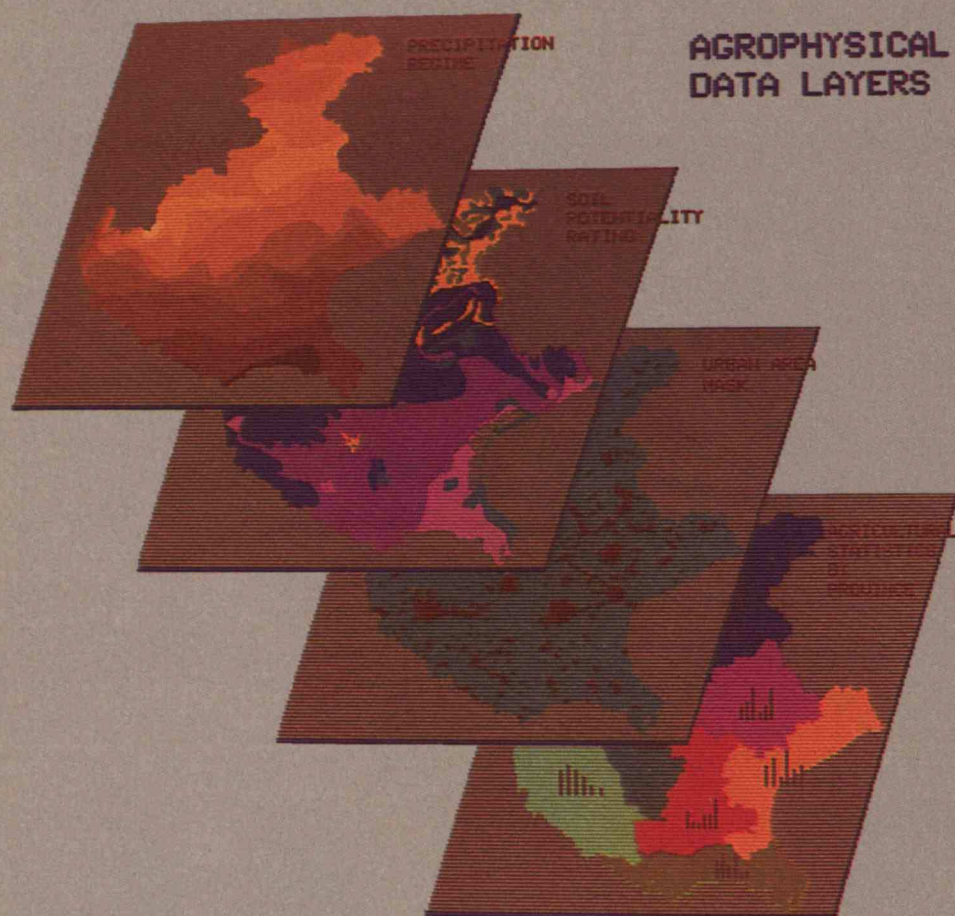
APS

BY DAVID BJERKLIE

The result is that conventional maps are increasingly failing to meet the needs of researchers, policymakers, and business, while other cartographic tools are emerging to compile, manipulate, and analyze geographic data in ways never before possible.

The transition began in the early 1960s. Canada's Federal Department of Agriculture was planning a national land inventory that would produce 1,500 maps to help assess the need to rehabilitate and develop marginal farmland. Roger Tomlinson, a geographer employed at an

*Computer representations
of geographic information are deepening
our understanding
of the world.*



The government of Italy and the University of California at Santa Barbara are using remote sensing and geographic information systems to map crops and model agricultural yields in the Veneto region. The goal is to improve production forecasts, which would not only make farming more efficient but help protect the environment.

*Geographic information systems
provide a window on many normally invisible attributes
of today's environments.*

aerial survey company, thought that a digital approach might accomplish the job faster and cheaper. Building on what little experience existed, a team he led assembled a database describing the area's natural resources, land uses, and socioeconomic profile. The team also created the analytical tools to evaluate the data. The Canadians dubbed their computer-assisted technique a "geographic information system"—GIS. That coinage has stuck.

GIS yields dynamic ways to visualize, compare, and analyze spatial relationships among large amounts of diverse data. Just as earlier maps made it possible to explore and comprehend the physical, social, and political worlds of their era, GIS provides a window on many normally invisible attributes of today's environments. Some analytical capabilities these systems offer simply do not exist with paper maps. But building such a system requires integrating several components. Researchers must assemble a database by digitizing the wealth of available geographic information. They must also develop computer hardware and software to manipulate and analyze that data.

Because GIS automates the analysis of spatial information, it forms a powerful basis for managing resources and understanding and predicting complex and changing systems—from weather to traffic patterns. Jack Dangermond, who is head of Environmental Systems Research Institute, a leading GIS developer, has compared the potential of computers in geography to the revolution that recombinant DNA technology has engendered in biology.

Markets and Maps

GIS is extending the historical functions of maps, which have long helped social and physical scientists understand more than the outcome of traveling in a particular direction. In *Early Thematic Mapping in the History of Cartography*, Arthur Robinson describes how nineteenth-century cartographers mapped patterns of pauperism, illegitimate births, and suicides. Especially notable were medical maps. In 1855 London physician John Snow plotted the location of cholera deaths, which led him to conclude that the source of the disease was a public water pump. Armed with this evidence, he persuaded city authorities to remove the pump's handle; new

cholera cases declined immediately.

In much the same way, GIS greatly expands the opportunities to predict the results of policy alternatives. Decision makers can allocate scarce city resources, manage timber harvests, and develop consumer markets within a framework that tracks historical data and extrapolates it into the future.

Nevertheless, the price tag for GIS initially confined the approach largely to selected uses in government and research. But like computers in general, GIS has become more affordable. A system that cost \$1 million 10 years ago might be available for less than half that today—in a more sophisticated version. And a low-end market is emerging for simpler needs: Apple Computer and others are developing personal-computer systems that will provide turnkey GIS capabilities for less than \$20,000. With declining costs, the uses are expanding. Currently estimated at about \$200 million annually, sales of geographic information systems are expected to double, perhaps triple, by 1992.

A growing number of retailers, including department-store giant Montgomery Ward, are discovering the benefits of going geographic. These firms want to know—down to the street address—where to locate their next store, service center, or fast-food outlet. GIS can help them find consumers of a specific age and income profile. Consequently, the packaging of digitized street-network files, national address directories, zip-code maps, and census tracts has become big business.

Consider a typical ad for GIS-based marketing tools in *American Demographics* magazine:

With a single tool, you can harness the power inherent in your own customer files, link it with every key marketing resource and form a predictive framework that gives you the clearest picture ever of your targets in any market in the country. Pinpointing who they are. Where they live and shop. How you can best reach them. All with amazing speed and precision. Think of what that can do for your profit picture.

Another growing market for digital geographic information is transportation. Albuquerque uses a digital map of the city's streets and highways to improve the efficiency of ambulance services. The GIS links a central computer, which tracks all emergency vehicles, to navigation devices in each vehicle. A dispatcher fields an emergency 911 call, checks the locations of available ambulances, and assigns the

DAVID BJERKLIE is a science reporter in New York City for Time Magazine.

The promise of the electronic revolution in cartography derives from transforming maps into bits and bytes.

nearest one. "The destination then appears on the screen in the ambulance," explains Stan Honey, who is an engineer with Etak, a firm that makes navigation devices. "The system plots the fastest route to the scene."

Similar tracking and navigation systems are improving efficiency for deliveries. United Parcel Service is planning to incorporate GIS routing into its nationwide delivery operations, and Miller Brewing Co. tracks and maps over 800 distributorship territories. In 20 cities, customers ordering pizza-to-go from Pizza Hut can call one central number; a system based on a computer map relays the sale to the nearest franchise.

More ambitious efforts aim to unsnarl urban traffic. Chicago has begun to couple traffic monitoring with coordinated electronic highway signs that warn drivers of problems ahead. This spring, California's Transportation Department plans to launch a three-year test of a system that electronically links traffic data to cars equipped with navigation devices. The system will inform drivers of road and traffic conditions and also outline routes that bypass trouble spots.

A few GIS products, typically billed as learning tools, are finding their way into the homes of consumers. A number of software programs—Software Concepts' *Atlas*, for example—package a digital atlas that serves many of the general reference purposes of standard maps. In addition, some of these atlases make it possible to compute distances between points, determine latitudes and longitudes, and locate places that share the same name. Other software programs—*Mapinfo*, *ExpressMap*, *Mapit*, and *Randmap*—can produce customized maps on home computers.

GIS is finding a steadily growing niche in research. Consider the problem of deciding where to drill for oil or natural gas. "You're trying to predict what you will find three-quarters of a mile under the earth, in order to convince management to spend half a million dollars to dig a hole in the ground," explains Frank Mayhood of Canadian Occidental Petroleum. Petroleum engineers have traditionally based their predictions on contour maps that show geologic formations and the locations of existing wells—both producing wells and dry ones. Digitizing this information allows geologists to produce three-dimensional representations. "We create maps to fit our exact needs," says Mayhood. "For geologists this

means faster access to more information. The system allows us to see the information more clearly and more flexibly, and to combine more data from different sources." GIS also lets specialists—petrophysicists, geologists, and geophysicists—work together. This speeds up finding a drilling location; "it also helps us sell our conclusions more persuasively."

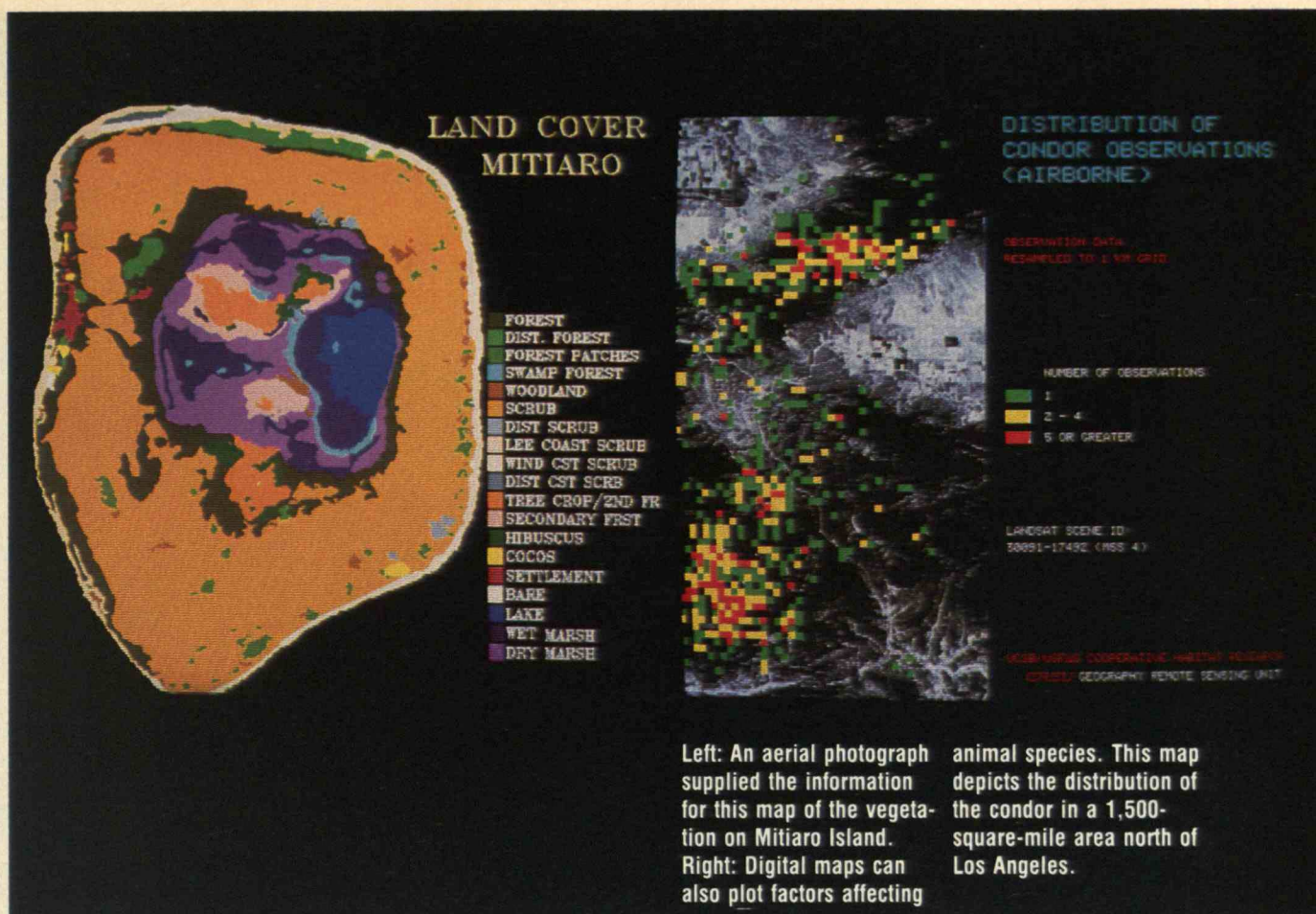
Origins of a Technical Revolution

While it is no wonder that the computer has been harnessed to handle unwieldy volumes of geographical data, it has also been enlisted in the somewhat more prosaic task of automating the printing of paper maps. Thirty years ago, the first computer-generated maps were produced on primitive line printers. Essentially throwaway study maps, these were crude representations indeed. With advances in both computer hardware and software, the graphic scope of computer-generated maps has expanded dramatically. Today, cartographers can use computers to create sophisticated highway maps that are virtually indistinguishable from those prepared by conventional techniques.

Nevertheless, the real promise of the electronic revolution in cartography derives from transforming maps into bits and bytes. Having geographic information in digital form gives researchers and policymakers a powerful handle on it. Computerizing maps provides the means to meet a great range of highly specific needs, since users can selectively extract required information from a massive database. By comparison, conventional maps are limited in the amount of information they can effectively convey. A paper map containing topographic, demographic, historical, and climatological information would be incomprehensible.

Consider the reservoir of data a local planning board might tap in picking the best place for a new landfill. Ownership titles and property lines might be detailed on one map, zoning restrictions on another. Soil types, subsurface geology, terrain, and drainage could be on still others. And local rainfall data, population projections, tax-base profiles, and development goals might exist only in text, tables, and charts. A GIS could contain all this information and correlate it with whatever factors a planning board might choose to consider.

The range of numerical operations that a GIS can perform on its database also far exceeds anything a



Left: An aerial photograph supplied the information for this map of the vegetation on Mitiaro Island. Right: Digital maps can also plot factors affecting

animal species. This map depicts the distribution of the condor in a 1,500-square-mile area north of Los Angeles.

human being working with a paper map could do. Even though human eyes and brains outpace the most sophisticated software in scanning and interpreting visual data, important kinds of analyses are feasible only with the computer. For example, calculating area, which is critical to managing resources and deciding how to use land, can be exceedingly difficult with a paper map. Often the most expedient solution is to take a scissors, cut out the areas in question, and weigh the paper scraps.

In fact, local governments are rapidly applying GIS to land-use planning. By consolidating geographic information from a variety of sources, municipalities are eliminating expensive redundancy. As Dangermond points out, most towns maintain a multitude of maps to track relevant data: "Public works keeps a set of map records, the planning department keeps a set, the fire department has their own, and every time something changes, all of those maps have to be updated by hand." A single GIS can store all these sets of geographic information. "When the database is updated, everyone's view is updated."

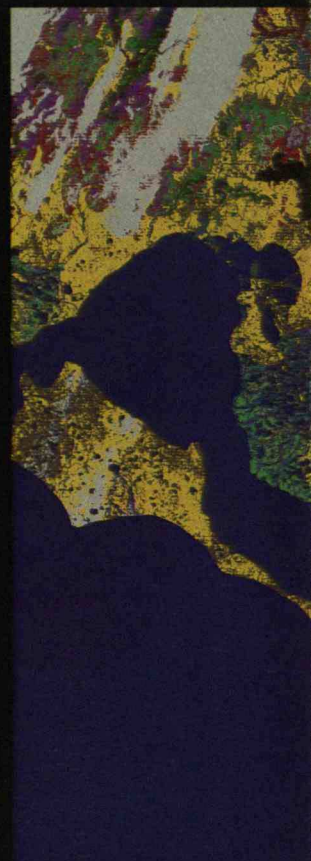
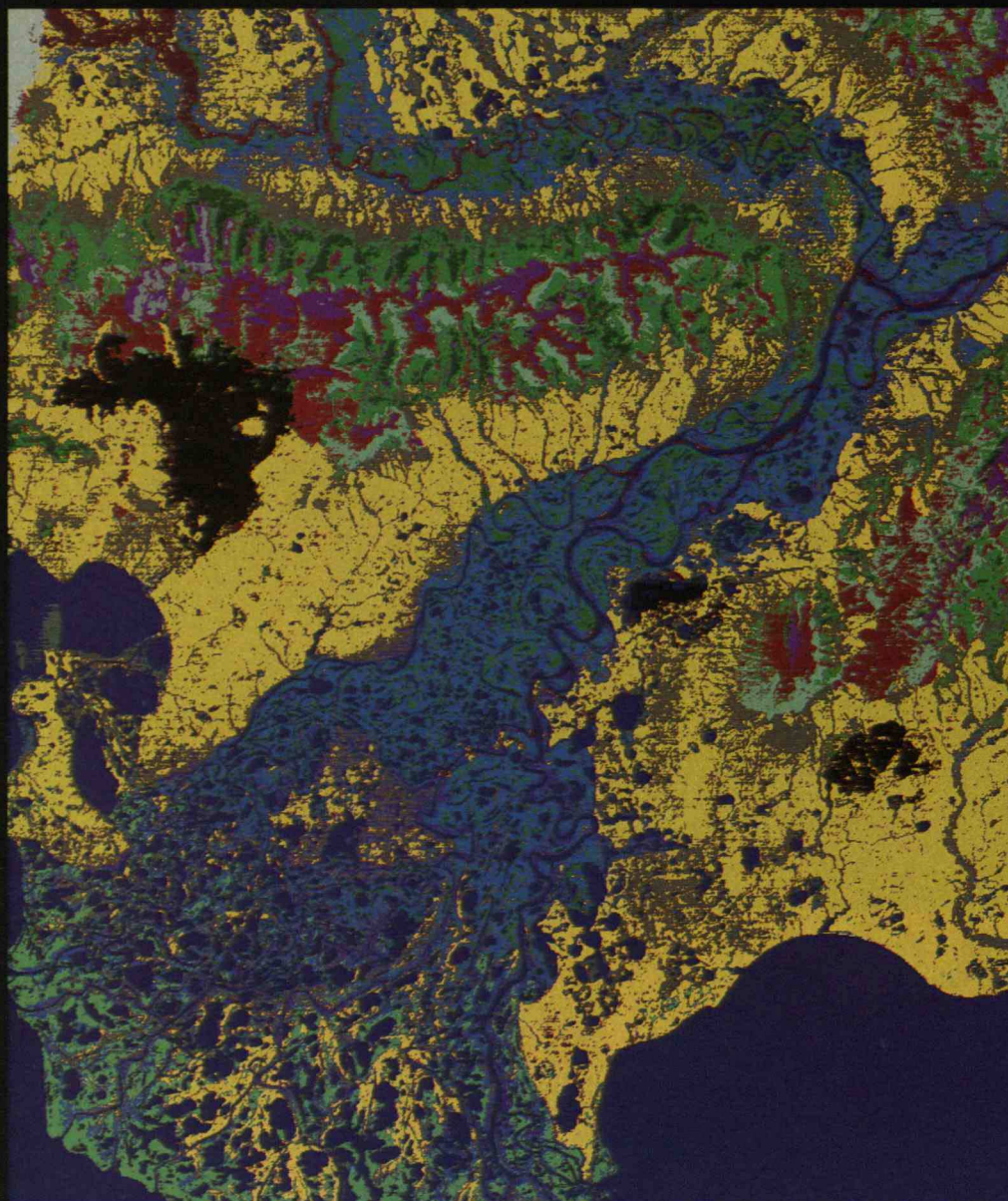
A GIS can fight the problem of inconsistent data as well. City departments each keep map records to suit their own needs, explains Dangermond. "The tax assessor needs parcel dimensions and tax identification numbers, the planner wants color renditions of land use, and the engineer needs geodetic

information at engineering scale and accuracy." But asking the same question of maps prepared for different purposes and at different scales and accuracies often yields different answers. According to Dangermond, "inconsistency in map information can drive managers and policymakers crazy. For example, when people dig holes, they sometimes run into things they didn't realize were there. All you have to do is hit a coaxial cable once and you've paid for the cost of a GIS that could have prevented it."

Siting Schools and Tracking Grizzlies

A community that creates a GIS database can use it for a wide span of operations. The same data can help officials decide where to place a sewage-treatment plant or an industrial park. It could also help determine where to build the next police station or elementary school. Minneapolis has used a GIS to relocate several fire stations after scrutinizing call-response times to various neighborhoods. The city's GIS has played a role in siting a new convention center and a garbage incinerator, too. Indianapolis, Louisville, Memphis, and Nashville have invested in GIS technology, and a four-year research project in Dane County, Wis., has demonstrated how GIS might help monitor soil erosion.

In addition, GIS can improve the scope and quality



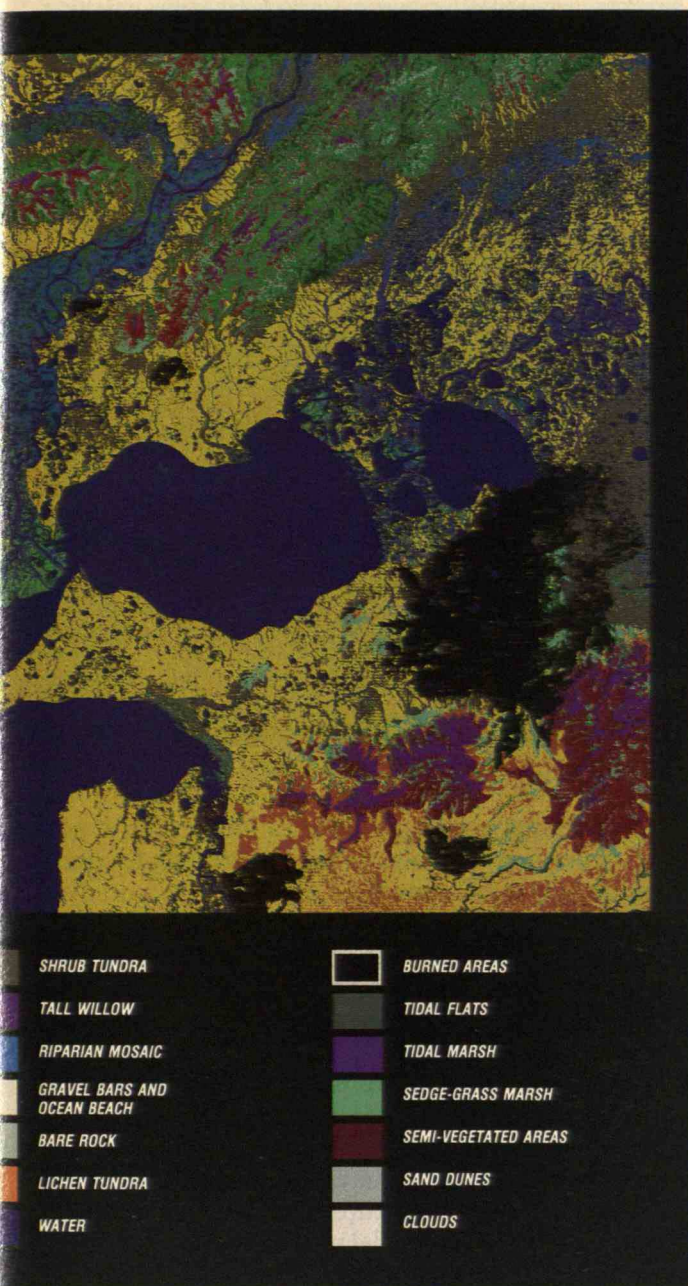
of land-use decisions at an impressive breadth of scales. Alaska's North Slope Borough is the largest Native American local government in the United States. Roughly the size of Minnesota, the borough must deal with comparably massive administrative challenges. Pressures to develop the largest proven U.S. oil reserves often threaten fish and game and traditional cultural institutions.

To better weigh different development and land-use alternatives, the borough created a GIS. Entered into the database were the results of a large-scale mapping program that included an environmental survey of soils, terrain, and wildlife, as well as extensive field research on the ecology of arctic vegetation. The GIS enables borough planners to create realistic "what if" scenarios.

Similarly, the National Oceanographic and At-

mospheric Administration is compiling digital atlases of important coastal areas to aid environmental assessment and fisheries management. The U.S. Forest Service is incorporating GIS into its silviculture programs, combining all planting, thinning, and harvesting files into one database. And the National Parks Service has incorporated GIS into its management operations, as has the Fish and Wildlife Service.

In the upper basin of the Colorado River, a GIS that predicts snow-melt runoff will help managers decide how high reservoir levels should be kept to meet summer water demands. Data on snowfall accumulation are being incorporated into an integrated geographic model of the watersheds. Each 1 percent improvement in the accuracy of runoff forecasts will save an estimated \$1 million in the cost of operating the reservoirs.



Near left: John Craighead and his colleagues have digitally mapped 13,000 square miles of arctic wilderness. Far left: This map displays vegetation and major physiographic features in the primary study area of 1,908 square miles.

munities, 46 of which have never before been described and classified.

The team is now correlating the ecospectral vegetation maps with a study of the home ranges of grizzly bears. By providing a better understanding of the habitat preferences of grizzlies, GIS-based maps might guide future oil development or road building in ways that lessen the impact on bears.

Digitally mapping ecosystems could yield a standard classification system, the project team concluded in a 1988 issue of *National Geographic Research*. "Such an ecospectral classification system, developed and applied worldwide, could immeasurably aid understanding of general ecological stability, the complexity of food chains, relative species diversity, and the relative ecological health of natural areas." As human beings encroach on wilderness areas, the authors note, digitally based ecosystem maps will be desperately needed to assess and mitigate further destruction.

GIS could offer a framework for prediction on a very large scale, modeling global changes such as the future impact of the ozone hole and the greenhouse effect. The key to this potential is the data structure and quantitative-analysis capabilities that GIS affords. Says Dangermond, "Few technologies have more promise for helping us understand the world around us and helping us solve some of the major world problems we face."

Models of global processes are in their infancy, but a consensus that efforts must be coordinated is forming, based partly on the extensive list of earth-observation experiments scheduled for the next decade. Projects to survey global ocean circulation and climate are under way, and proposals to map the earth's soils, hydrology, and agricultural production are in the works. These are sponsored by various international agencies and organizations, including the International Society for Soil Science, the International Union of Geologists, and the United Nations' Environment Program and Food and Agriculture Organization.

The International Council of Scientific Unions (ICSU) is launching a comprehensive program to monitor and model global change. One of its objectives is to create a worldwide digital cartographic database. Toward that end, ICSU has established a planning forum, and representatives of organizations with existing and proposed global digital databases attended its first meeting in May 1988. GIS

Maps as Crystal Balls

As scientific descriptions, GIS models could open up a wide range of future studies. A sophisticated example of this is "ecospectral" mapping. Attempts to classify the earth's ecosystems according to the type and distribution of vegetation date from the sixteenth century. With remote sensing and digital maps, ecosystem classification can be far more detailed. In a recent project, John Craighead and his colleagues at the Craighead Wildlife-Wildlands Institute in Missoula, Mont., have digitally mapped 13,000 square miles of arctic wilderness. The researchers have found that certain plant groups identified on the ground can be matched to specific color codes in *Landsat* photos. As a result, Craighead and his colleagues have identified 68 distinct plant com-

Automobile navigation systems can indicate a vehicle's origin, position, and destination. They also can locate an address or show which streets are one-way.

pioneer Roger Tomlinson believes these moves are a huge step in the ability "to describe, explain, and perhaps make better decisions about the world."

A Diet for a Data Gobbler

Despite these heady prospects, geographic information systems face many problems. "To assume that maps will be better—more accurate, more timely, more accessible, more aesthetic, more tailored to user needs—simply as a result of high technology is unreasonably naive," writes Syracuse University geographer Mark Monmonier in *Technical Transition in Cartography*. He believes that management and organization are the greatest obstacles to implementing the new technologies. According to Monmonier, "The potential for better maps has never been greater, yet neither has the threat of dismal, expensive, embarrassing failures."

One factor that has limited the accessibility of GIS is cost, not only of the systems but of the data on which they depend. Some databases exist in the public domain, but others can be very expensive, especially those collected from satellites. Certainly in many cases the price of information will determine who will apply it and how. Not everyone can afford to spend tens of thousands of dollars for data from satellites.

The foremost technical problems also involve data—the lack of it as well as the glut. "The big myth is that the data is all there," says University of Wisconsin geographer David Woodward. "People are buying GIS packages thinking that everything they need is already in it." They are often mistaken. In a great many instances, the data for prospective GIS uses simply haven't been compiled, although by the year 2000, the U.S. Geological Survey (USGS) expects to complete a National Digital Cartographic Base. It will include all the information that now appears on the agency's map series. And the USGS is collaborating with the Census Bureau to more accurately digitally map and integrate a broad spectrum of demographic data in the 1990 census.

When contemplating data collection, economics become critical. "Just because GIS can consume enormous quantities of data, we can't assume that society is going to want to pay for continuous data acquisition," says cartographer Barbara Petchenik, managing editor for a special issue of the *American Cartographer* on the history of GIS technology.



While a global view of deforestation or the ozone hole is extremely important, governments may resist spending the huge amounts of money required to collect the data. What is needed, says Michael Goodchild of the University of California at Santa Barbara, is a better link between data collection and objectives. "We need to define much better the kinds of data we need for particular kinds of analysis."

Even when the requisite information is available, coordinating it is a major concern. Different communities have different software, levels of data accuracy, and database structures. Until standards for accuracy and data structures are adopted, systems will be difficult to link, delaying integrated state or national applications.

Statistical analysis could make it easier to combine different sets of data. "We know we can't have absolute accuracy. So we need to understand the effect error in a database will have on the rest of the system," says Woodward. At a new National Center for Geographic Information and Analysis (NCGIA), researchers are trying to better characterize error and track its effect on models. The center is located at the University of California at Santa Barbara, with branches at the University of Maine at Orono and the State University of New York at Buffalo. "There are a lot of models being built today that are very sensitive to error," explains Goodchild, who co-directs the NCGIA with David Simonett. He cites the example of global climatic models, in which a small error in one piece of data is magnified as it is extended worldwide.

Established through a \$5.5 million grant from the

*Some geographic information systems
dispense with visualization altogether. Others are ephemeral,
existing only on a computer screen.*

National Science Foundation, the NCGIA is the first that agency has founded in social science. The center will train experts, promote the spread of GIS analysis, and study the social, legal, and institutional aspects of GIS. It will also be a clearinghouse for research, teaching, and applications.

In addition, the center will examine ways to improve and better use geographic information systems. Particularly important is the question of how to represent three-dimensional geographical reality as mathematical relationships in a computer. Dangermond feels that failure to meet this challenge limits GIS applications. "Many of the mathematical models we're working with were crudely developed 20 to 40 years ago," he says. "We need data structures good enough to hold all the relationships of movement and change."

Maps That Aren't There

Such obstacles notwithstanding, the myriad ways that government bodies, researchers, business, and the public already apply GIS demonstrate how profoundly the new cartography affects the concept of geographic knowledge. GIS represents more than a technological revolution, emphasizes Petchenik. "It has changed and will continue to change the ways we think about geographic relationships and about spatial knowledge itself." It raises fundamental questions about what a map is and how we use it.

The importance of these questions is illustrated by the track record of one mass-market GIS item: car navigators. These devices use a dashboard map display and an on-board computer to indicate a vehicle's origin, position, and destination. The system adjusts continuously, tracking the driver's progress through city streets. The driver can also ask the device to locate an address or indicate the direction of all one-way streets.

The first car navigators appeared several years ago but didn't catch on. Present systems are more refined—displays are more sophisticated, and navigation options have been added. But will drivers find these devices easy enough to use? Will they find them useful enough to bother with?

The problem goes beyond technical feasibility. According to Petchenik, manufacturers of car navigation devices have largely failed to consider that a map is not information in and of itself. "All it can do is create sensation in your eye and brain. It's what

then happens in the human being that is critical. The integration and utility of the map representation happens inside the human mind."

The dilemma is that we know far too little about how human beings process map information. In *The Nature of Maps*, Robinson and Petchenik point out that "even the simplest map is a remarkably complicated instrument." Applying the new GIS tools effectively requires understanding more about how the human mind extracts meaning from maps. Petchenik concludes, "We're trying to develop a new tool and we don't know what the specs are on the creature we're developing this tool for."

The navigation systems are one example of how maps are becoming an interactive mix of data and software, rather than a permanent record or even a concrete object. Some geographic information systems dispense with visualization altogether—for example, the self-navigator for a cruise missile employs no visible map. Certainly GIS won't eliminate printed maps—to the contrary, most applications will probably generate more of them than ever—but many maps will hardly be recognizable as such. Some will be ephemeral, existing only on a computer screen. Others may be animated, perhaps illustrating the changing course of immigration or the shifting of continental plates.

No matter what shape geographical representations take, they will continue to record the history of exploration and discovery. For centuries, maps have pictured new worlds taking shape, borders being fixed, terra incognita rendered familiar. In the same way, our modern cartographic views may mirror contemporary priorities and perspectives in managing global resources. Comprehending phenomena such as the geophysical world of offshore gas fields and the biological world of shrinking rain forests requires understanding their underlying geography, the character of their patterns over time and space.

It is impossible to predict exactly how GIS will be used. Yet it is safe to assume that the needs for and uses of geographic information will continue to expand and diversify, both affecting and reflecting technological capabilities. GIS will enhance our ability to understand phenomena as varied as Pacific Rim economies, the emergence of religious fundamentalism, the loss of arable land, and the epidemiology of AIDS. The outcome will be a deeper knowledge of the spatial nature of the world and the dynamics of its societies. ■

Ill Winds

Air Pollution's Toll on Trees and Crops

Across the United States, forest trees and crops are under attack. Many ponderosa and Jeffrey pines in southern California's San Bernardino National Forest have died over the past three decades. On well over 100,000 acres of this land, pines are aging faster, growing slower, and succumbing more easily to insects than they did 30 years ago. Likewise, at elevations above 2,500 feet in the Northeast, half the red spruce trees that appeared healthy in the early 1960s are now dead. And throughout the Farm Belt, certain major crops are growing slower than they should be or have leaves that are misshapen or discolored.

Mounting evidence of harm to plants is a sign that America needs tougher air-quality legislation.

What's the assailant? In each case the evidence points to air pollution. Together or separately, ozone and acid precipitation from the burning of fossil fuels are weakening trees in U.S. forests, leaving them more vulnerable to natural stresses. And ozone is adding to the burdens of the American farmer by reducing agricultural productivity to the tune of billions of dollars a year.

Although scientists have suspected for some time that air pollution is contributing to forest declines—especially in central Europe, where the problem is most severe—evidence has until recently been scant. It is still hard to separate out the role of other factors, such as weather extremes, insects, and competition among species. But now that numerous studies of forest

JAMES J. MACKENZIE AND
MOHAMED T. EL-ASHRY





*Mountain forests in the East
may be covered in acidic fogs and clouds
for up to 3,000 hours each year.*

declines have been completed in both the United States and Europe, the evidence implicating airborne pollution is too strong to ignore. The case that air pollution, primarily ozone, is damaging crops is even more compelling. This is partly because greater resources have been devoted to crop research and partly because the ecology of agricultural systems is simpler.

As crops and trees are added to the list of entities threatened by air pollution—which already includes lakes and streams, aquatic life, materials, scenic views, and human health—the policy imperatives for the United States are now clearer than ever: the federal government must devise a more effective air-pollution control strategy and work with industry to develop clean sources of energy.

What's more, the time to act is now. In the first place, the Clean Air Act is up for renewal, and Congress will be considering ways to strengthen the legislation so that it achieves what it has thus far failed to do: protect public health and the environment from both primary pollutants and the secondary pollutants into which they are transformed. In the second place, without an effective abatement strategy for the long term, the harm caused by ozone and acid precipitation will only get worse. The use of fossil fuels is expected to increase significantly in the coming decades. Unchecked, this growth will not only hasten direct damage to the environment but also aggravate the global greenhouse problem.

Our Endangered Forests

Besides the declines that have hit the San Bernardino National Forest and northeastern red spruce, there are other instances of dead and dying trees that cannot be explained by natural processes:

■ Surveys begun during 1983 on Mt. Mitchell in North Carolina and five other southern Appalachian peaks show that the growth of red spruce and, to a lesser extent, Fraser fir fell markedly at elevations over 6,300 feet beginning in the early 1960s. By 1987 almost half the red spruce and Fraser fir on Mt. Mitchell's west-facing slopes (the windward side) were dead.

JAMES J. MACKENZIE, a former energy policy analyst for the Union of Concerned Scientists, is a senior associate in the Program in Climate, Energy, and Pollution at World Resources Institute in Washington, D.C. MOHAMED T. EL-ASHRY is the institute's vice-president for research and policy affairs. Previously, he directed the environmental programs at the Tennessee Valley Authority. The authors' report "Ill Winds: Airborne Pollution's Toll on Trees and Crops" was published by World Resources Institute in 1988.

■ Tennessee, Virginia, and North Carolina contain 66,000 acres of spruce-fir forests. On a quarter of this land, more than 70 percent of the standing trees are dead.

■ Throughout the Piedmont and mountain areas of the Southeast, the radial growth rates of most yellow pines under 16 inches in diameter have dropped by 30 to 50 percent over the past 30 years. The mortality rate has increased from 9 percent a year in 1975 to 15 percent in 1985.

■ White pines throughout the eastern United States have been deteriorating for several decades. They grow less in both height and diameter, and have shorter needles that die at the tips.

■ In the Northeast, sugar maple, yellow birch, American beech, white ash, white spruce, and balsam fir are also showing symptoms of decline.

At some high-elevation sites, trees have been declining for almost 30 years; at others, symptoms have developed only within the past decade. What all these sites have in common, however, is that they are subject to high levels of air pollution. Most sites have much higher than average concentrations of ozone, which forms when nitrogen oxides and hydrocarbons (both produced when fossil fuels are burned in power plants, industrial boilers, and vehicles) undergo photochemical reactions in the air. The San Bernardino National Forest, for example, lies 75 miles east of the ozone-fraught Los Angeles basin. And in the high-elevation Appalachian sites where red spruce and Fraser fir are declining, ozone levels average twice those of lower neighboring elevations. This is because the ozone concentrations, for reasons not fully understood, do not fall at night as they do at lower elevations.

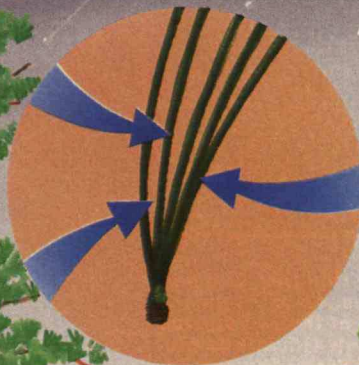
Acid deposition is also high at many sites, especially in eastern mountains, where forests may be covered in acidic fogs and clouds for up to 3,000 hours each year. The acids in question—nitric acid and sulfuric acid—form in the atmosphere from emissions of nitrogen oxides and another by-product of combustion, sulfur dioxide. They are carried to earth not only by clouds, fogs, and rain but also by dry deposition, in which gases and acid particles settle out of the air.

Cloud samples taken on Mt. Mitchell during 1986 showed a pH varying from 5.4 (slightly acidic) to as low as 2.2 (about the same as vinegar), with a mean pH of 3.4. The minimum, or most acidic, pH for two other eastern mountains was similar: Whiteface Mountain, in New York, 2.8; and Whitetop Mountain, in Virginia, 2.6. The rate of sulfate deposition on Vir-

Air Pollution Attacks a Tree

Pollution works its mischief in a variety of ways—though not necessarily all at the same site. In some places, for example, the main culprit is ozone. In others, acid is deposited more by clouds and fogs than by rain.

OZONE ENTERS PORES OF NEEDLES OR LEAVES, DISRUPTING PHOTOSYNTHESIS, ACCELERATING NUTRIENT LEACHING, AND INHIBITING WINTER HARDENING.



ACID RAIN...

... LEACHES NUTRIENTS FROM FOLIAGE...

... ACIDIFIES SOIL...

... DEPOSITS EXCESSIVE NITROGEN...

... RELEASES ALUMINUM FROM MINERALS...

... AND LEACHES NUTRIENTS FROM SOIL.

ALUMINUM IONS

(WHICH THEN DAMAGES FINE ROOTS AND BLOCKS ABSORPTION OF NUTRIENTS)



Over the past two decades, 40 to 70 percent of the red spruce at high elevations on New York's Whiteface Mountain have died, apparently because of acid deposition and ozone combined with natural stresses. Nationwide, much of this pollution forms from sulfur dioxide and nitrogen oxides emitted by electric power plants (inset).

ginia's Whitetop Mountain was about 10 times that of lower elevations from April through December of 1986. Similarly, annual hydrogen ion deposition—a direct measure of acidity—is roughly 10 times as high on Mt. Mitchell as at lower elevations.

Damaging Evidence

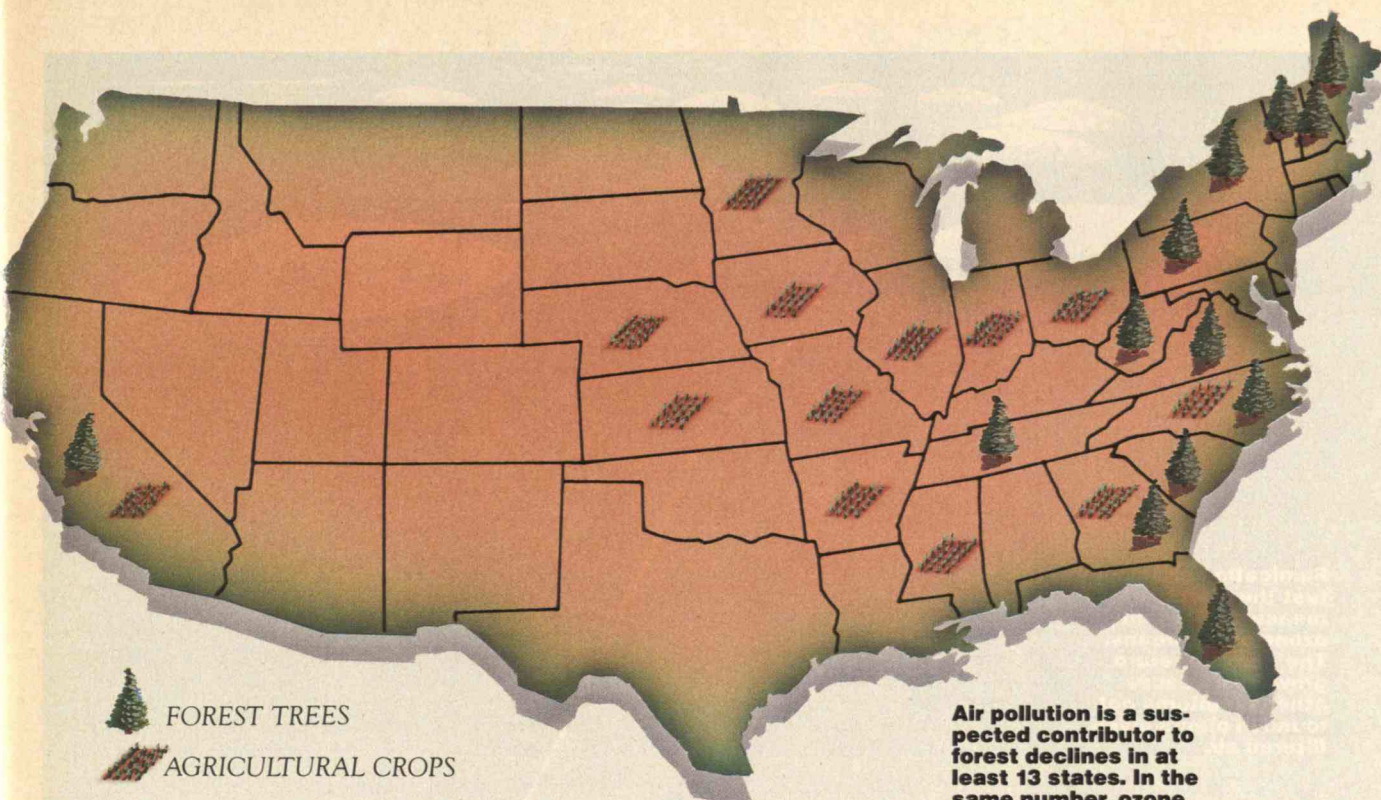
Of course, it's one thing to note that ozone and acid precipitation are present where trees are dying or being injured, but quite another to prove that these pollutants are contributing to the damage. In many cases the immediate cause of the decline is a natural stress such as winter cold, insects, or disease. In other cases, such as the declines in the San Bernardino mountains, the symptoms do not match those of any natural affliction. The present understanding is that these declines result from multiple stresses, with air pollution playing an important—and sometimes essential—role.

Various studies have shown that the levels of pollution at the affected sites can indeed weaken trees, causing nutrient imbalances and lowering the rate of photosynthesis. In the early 1950s, when damaged needles first appeared on San Bernardino's ponderosa pine, scientists enclosed some of the affected branches in chambers. They then fumigated the branches with the surrounding ozone-rich air, with filtered air, or with

filtered air plus measured amounts of ozone. The branches in the filtered air improved, while the others continued to deteriorate. These and later fumigation experiments confirmed that ozone was causing the damage.

Subsequent research has shown that ozone enters the pores of leaves and needles. It damages the membranes of cells that contain chlorophyll, leading to reduced levels of photosynthesis and thus inhibiting growth. In addition, preliminary findings by scientists at the Boyce Thompson Institute in Ithaca, N.Y., suggest that ozone interferes with winter hardening of red spruce, making them more vulnerable to extreme cold.

Investigators have also identified a number of mechanisms by which acid deposition directly and indirectly injures trees. On Mt. Mitchell, for example, recent experiments with red spruce by Robert Bruck and his colleagues from North Carolina State University have shown that acid deposition can damage the wax plugs in the pores of needles. Since these plugs are believed to minimize water loss in the plant and help in the exchange of gases, such injury can retard growth. The same researchers have shown that acid leaches nutrients from foliage. Rainwater dripping off spruce needles on Mt. Mitchell contained a lot more magnesium, calcium, potassium, and sodium than rainwater that missed the trees. Leaching by acids is especially se-



Air pollution is a suspected contributor to forest declines in at least 13 states. In the same number, ozone cuts crop productivity by \$100 million or more (over \$5 billion total).

vere when ozone levels are also high.

More threatening than direct damage to foliage are the many indirect changes that acids can bring about by altering soils. First, acid deposition can leach important nutrients out of the soil, replacing them with hydrogen ions and acidifying the soil in the process. Trees growing on such soil may suffer nutrient imbalances that lead to decline.

Second, high levels of acid deposition can release aluminum from minerals in the soil. Aluminum ions damage the fine roots of trees and block the uptake of calcium and magnesium. George Tomlinson, a tree chemist with Domtar Research Centre in Quebec, and Walter Shortle and Kevin Smith, of the U.S. Forest Service, have observed this blocking effect in the Northeast. High levels of aluminum can also impede the flow of water within the tree, increasing its sensitivity to drought.

Finally, because of its nitric-acid component, acid precipitation can overload forest ecosystems with nitrogen. By one recent estimate, seven times as much nitrogen is deposited at a high-elevation New Hampshire site as at low elevations. Nitrogen is a vital fertilizer, but if the soil is lacking in other nutrients, the growth spurred by an overdose of nitrogen can lead to nutrient imbalances. Too much nitrogen can also make a tree more susceptible to freezing or drying out in winter.

Of course, not all these mechanisms will apply at any one site. Moreover, the actual rate at which leaching occurs—and the amount of damage it causes—depends on the condition of the soil, the amount of acid that is deposited, and other factors.

So far, the declines have hit only those forests with very high pollution levels. Nevertheless, it's possible that the damage could eventually spread to less polluted areas. If it turns out that lower levels of acid deposition lead to significant nutrient leaching, the same injuries could result over a long period as result from higher levels over a short period. Thus, it may be only a matter of time before forest declines in the United States become as serious as those in West Germany, where trees of all important species at all elevations are showing signs of damage. Indeed, a team from Oak Ridge National Laboratory that studied the soil chemistry of forests in 1986 found that 41 percent of eastern soils are susceptible to substantial nutrient leaching and thus to forest decline.

Injured Crops

It's hard to put a dollar value on the trees that are now declining, since most are on state or federal land. But the economic losses that air pollution causes to crops have been estimated as part of the Environmental Pro-



Fumigation chambers test the effects of measured amounts of ozone on soybeans. The gas can retard growth and cause other symptoms not found in plants given filtered air.

tection Agency's National Crop Loss Assessment Network (NCLAN), a program that ended in 1987. According to Walter Heck, of the Department of Agriculture's Air Quality Research Program, who chaired NCLAN's research committee, cutting ozone levels by 50 percent would increase yields for four major crops—soybeans, corn, wheat, and peanuts—by up to \$5 billion. Overall, ozone from burning fuel is estimated to reduce crop yields by 5 to 10 percent.

Unlike forests, crops appear to suffer little or no damage from existing levels of acid deposition. Agricultural soils are well fertilized, so crops can readily replace the nutrients they may lose through leaching. But ozone is not so easily countered.

As with trees, ozone enters crops through the microscopic pores on the leaves and attacks cell membranes inside the plant. If the amount of ozone in the air is small enough, plants can generally detoxify the gas or repair the damage. But the prevailing level of ozone during the growing season in most U.S. agricultural regions is double the background level. At this concentration, many plants cannot repair cell damage fast enough. The effects include yellowing, tissue death, reduced growth, decreased yield or crop quality, and greater susceptibility to stress.

In contrast to forest declines, which so far have been confined to scattered sites, the losses in crop productivity are pervasive. Various economic analyses estimate that in each of 13 states the losses exceed \$100 million a year.

Turning the Tide

Air pollution is already taking a heavy toll on America's forests and crops. And the toll will rise unless more is done to curb emissions. Under current regulations, nitrogen-oxide pollution from power plants is expected to double by 2030. Over the same period, nitrogen oxides from transportation, industry, residential and commercial heating, and waste incineration are likely to increase by 30 percent, and hydrocarbon emissions by 25 percent. By 2010, emissions of sulfur dioxide are expected to be no lower, and perhaps slightly higher, than they are today.

Fortunately, there is much that we as a nation can do to turn the tide. And many of the steps we take to improve the air for crops and forests will reduce ill effects on human health and global climate. In lessening the threat to one domain, we will also lessen the threat to others.

A good place to start is with more effective legislation for reducing emissions of sulfur dioxide and nitrogen oxides. In 1970 and 1977, when the last two important amendments to the Clean Air Act were passed, scientists knew much less about how pollutants form, travel, and interact, and thus did not foresee the large-scale problems of acid deposition and high rural ozone levels. Legislators also failed to anticipate how fast the number of pollutant sources would grow. The act therefore focused on limiting emissions from individual vehicles, power plants, and factories. This ap-

*As well as curbing emissions,
the United States should be preparing for the inevitable
shift to nonfossil energy.*

proach at first led to a significant drop in emissions, but it still allowed the nation's total emissions to increase.

New legislation should impose state or regional caps on the release of sulfur and nitrogen. To decrease sulfur-dioxide pollution (80 percent of which comes from power plants and industrial processes), the act should require a 50 percent reduction in such emissions—to 10 million tons a year—over a period of, say, 10 years. This goal is consistent with the National Academy of Sciences' conclusion that cutting acid deposition in half would probably protect sensitive aquatic life. It would also go a long way toward safeguarding trees and crops.

Each state should then be permitted to choose among various options for meeting the new goal as cost-effectively as possible. A state could encourage its coal-burning power plants to convert to "clean-coal" technologies (such as fluidized-bed combustion) or to switch from one fuel to another—say, from coal to natural gas. Or a state could trade emissions, both among sources within its borders and with neighboring states. For example, if a power plant in one state could convert to clean coal more cheaply than a nearby plant in a second state, the first might offer to convert its plant in exchange for some concession from the second.

A state might also encourage the use of more efficient appliances, lighting, and other equipment, to reduce the need for electricity. According to a study of seven east-central states, such conservation measures could cut power consumption during the 1990s by 26 percent from projected levels and sulfur-dioxide emissions by 7 to 11 percent.

Nitrogen-oxide emissions (of which the main source is motor vehicles) can be reduced in much the same way. A reasonable goal would be to cut annual emissions by 5 million tons over the next decade—a 25 percent reduction from 1986 levels but a much larger reduction from projected growth. This goal can be reached through a combination of stricter emission limits for cars, buses, and trucks; strengthened inspection and maintenance; and stronger measures to prevent tampering with pollution-control equipment. The use of cleaner fuels, such as compressed natural gas, in commercial fleets and urban buses would also be beneficial.

A number of other straightforward measures could reduce pollution by cutting the total number of vehicle miles traveled. For example, cities could encourage greater use of public transit, reserve parking spaces for car pools, remove subsidies for other spaces, and designate more traffic lanes for car pools and bicycles.

To raise fuel efficiency, and thereby lower pollution levels, federal and state governments could increase fuel taxes, as well as tax new vehicles according to their gas mileage. (Annual registration fees could also vary this way.) In addition, governments might buy mostly ultra-efficient vehicles for their own fleets.

These and other measures for cutting emissions would lessen the damage to trees and crops and reduce threats to public health. Yet two serious fuel-related problems would remain: growing U.S. reliance on foreign oil and the steady increase in global warming. In principle, the nation could solve the first problem by converting to coal, which is abundant and which could be turned into methanol (to replace gasoline) or synthetic crude oil. But this would aggravate the second problem. The burning of fossil fuels, especially coal, releases vast amounts of carbon dioxide that contribute to greenhouse warming. The only way to protect natural resources *and* contain oil imports *and* slow global climate change is to burn much less fossil fuel.

Thus, at the same time it is working to curb emissions, the United States should be preparing itself for the inevitable shift to nonfossil energy sources. The renewable-energy technologies—solar cells, wind turbines, hydropower, geothermal energy—are strong candidates to assume the burden of future power production. "Second-generation" nuclear technologies (small, inherently safe fission reactors) offer another, though less certain, option. In the long term, transportation is also due for some profound changes, perhaps a switch to electric or hydrogen-powered cars, with the electricity or hydrogen ultimately derived from nonfossil sources.

These technologies will require considerable R&D, and probably major government initiatives, before they can be applied on a grand scale. But once they are in place, nonfossil technologies will alleviate a whole range of national problems—not just tree and crop damage but urban air pollution, climate change, and dependency on foreign oil as well. ■

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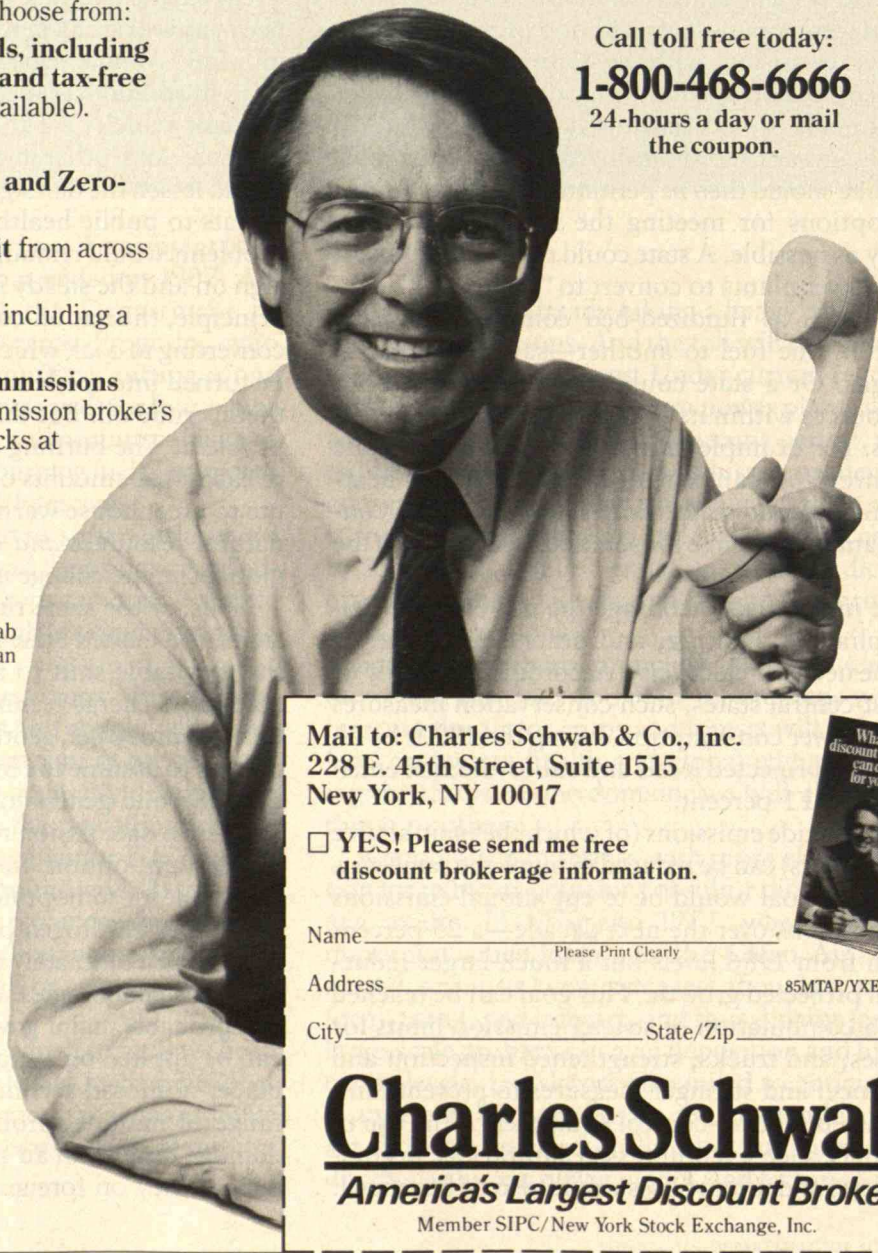
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Reviews

THE MEDIA

Yo-Yo Journalism and Nuclear Power

BY FRED JEROME

In case you hadn't noticed, nuclear power has had a revival, at least in media reports, since last summer's drought and concern about the greenhouse effect. It is simply one more of many media swings on this complex issue.

In the early 1950s, when President Eisenhower announced the "Atoms for Peace Program," press coverage reflected the upbeat atmosphere. America would show the world how to beat bombs into industrial plowshares, and what's more would save millions of energy dollars in doing so. Nuclear power would be, in the words of a slogan publicized by the press, "too cheap to meter."

For 15 years, while utilities were putting up nuclear plants like Monopoly houses on Park Place and Boardwalk, media coverage reflected the almost unlimited optimism about technology that characterized postwar America. Reporters virtually ignored the few critics raising questions about health, safety, and disposal of nuclear waste.

In the 1970s, as the cost of nuclear power escalated and several older plants began to show signs of wear and tear, media coverage took on a more critical tone. By the end of 1974, plans for more than 100 nuclear plants had been canceled or postponed, and in January 1975 the Nuclear Regulatory Commission ordered 23 of the 52 U.S. plants shut down temporarily for safety checks. The press reported these developments, but it was the accident at Three Mile Island 10 years ago this month that really transformed news reports on nuclear power.

If Walter's Scared. . .

Who can forget Walter Cronkite's frightened eyes as he reported the Three Mile Island accident to millions of viewers? The power of television was never more clearly demonstrated, as something close to public panic set in. In New York City, airports and train stations were swamped by thousands of calls from people seeking the fastest way out of town to avoid the feared radiation disaster. "If Walter's scared, I'm scared," one woman told the *New York Times*.

During the next decade, the press gave



wide coverage to every leak, spill, cost overrun, and picket line at nuclear plants throughout the country. Hardly any media outlet examined why, if the industry was so onerous, many other countries were turning to nuclear energy as the answer to their dependence on imported oil. One notable exception was an NBC TV documentary by Reuven Frank that detailed the progress of French nuclear power. But for the most part, the same one-sided approach that had earlier made atomic energy the darling of the American press was transformed, like a jilted lover, into equally unquestioning opposition. "Nuke" became a four-letter word in the American press.

Then, suddenly last summer, things changed again. The heat wave, polluted beaches, drought, and rotten air left policymakers frantically discussing alternatives to fossil fuels, whose by-products were blamed for the misery and the widely predicted catastrophe-to-come from global warming. The pollution solution most frequently proposed in these discussions was nuclear power.

Most dramatic was the change in opinion among many environmentalists. Groups such as the World Resources Institute and the Natural Resources Defense Council, as well as *Environment* magazine, publicly called for a reassessment of nuclear energy. As Colorado Senator and former nuclear opponent Tim Wirth told *Newsweek*, "Those nations that have halted the nuclear option are going to have to reconsider."

And once again, the vast majority of the media shifted with the wind. Last fall, the *Wall Street Journal* and the *New York Times* carried lengthy articles on two new reactors: a redesigned breeder reactor (*Journal*), and a small gas-cooled modular one (*Times*). "Experts Call Reactor Design 'Immune' to Disaster" read the *Times* headline. Both articles cited mounting concern about global warming as the basis for interest in the new designs.

Yet although both reactors are still experimental, neither article cited any criticism (including that from nuclear supporters) or mentioned economic and developmental hurdles still to be overcome. This was in marked contrast to coverage of "break-throughs" in medical research, where leading publications invariably emphasize that the findings await further testing.

Times science editor Eric Eckholm says that his paper was simply responding to an important development—"many environmentalists and politicians are now saying the greenhouse effect has made the nuclear option more tangible." No doubt the two papers did not set out to slant their stories. But they clearly reflected the media's tendency to "go with the flow" of current opinion.

However, the clearest sign of a media swing toward nuclear power came in editorial columns. A *Times* editorial on June 23 argued for "cheaper, safer nuclear power," adding, "Nuclear plants produce no carbon dioxide or acid rain." And the *Washington Post* echoed on August 14, "Increased reliance on nuclear energy would be essential to any serious attempt to stabilize the climate."

By October, editorials in virtually every major news magazine and newspaper in the country, and many smaller ones, argued that the greenhouse effect requires at least a new look at nuclear power. Summing up the general sentiment, the *New Republic* declared: "All we are saying is give nukes a chance." And the *Boston Globe* labeled the Massachusetts referendum to shut down nuclear plants the "greenhouse initiative." (The measure was overwhelmingly defeated at the polls in November.)

Technological Fix

Remaining critics of nuclear power are, understandably, dismayed by all this. "Journalists, including science writers, have a reflexive attraction to the technological fix," says Norman Solomon of Fairness and Accuracy in Reporting. "They're always looking for more complicated technology to solve

If next summer is cooler than last, we may well see another media shift against nuclear power.

every problem. It's very dangerous—that's how we got into the nuclear power mess to begin with." Solomon, coauthor of the 1982 book *Killing Our Own: The Disaster of America's Experience with Atomic Radiation*, calls the latest swing in the fortunes of nuclear power "a combination of shoddy journalism, wishful thinking, and a predisposition to well-funded sources."

Surprisingly, the energy industry has not been ecstatic over the editorial shift, either. Representatives of the utility-funded U.S. Council for Energy Awareness (USCEA) are disturbed because so many of the public comments call for new types of reactors. "They are demanding zero-risk, ultra-safe reactors," a spokesman for USCEA protests. "That kind of approach will never get anywhere."

Industry people say they have modified their traditional light-water reactors to be safer and cheaper, with smaller modules that can be ordered as energy demand grows. "The U.S. industry knows light-water reactors," the spokesman said. "The other de-

signs are untested and not needed."

Still, in the ups and downs of yo-yo journalism, nuclear is definitely on the upswing again. Of course, the media didn't create last summer's drought any more than they provoked the accident at TMI (not to mention Chernobyl) or the earlier optimism. But should the press simply mirror—and magnify—swings in public opinion? Have the media become, as a *Times* op ed piece argued regarding election coverage last September, "mere stenographers to power"? It's as if an unseen leader of the pack held a finger in the air to see which way the wind was blowing and then took off in that direction with the rest close behind.

What ever happened to the questioning reporter, the doubter, the challenger? Surely the issue of nuclear power offers a perfect opportunity for good old-fashioned investigative journalism. For example, how are France, other European nations, and many countries in Asia and Latin America (including, by the way, Cuba) coping with nuclear plant safety and spent-fuel disposal? And

what are the Russians doing after Chernobyl?

If next summer is cooler than last, we may well see another editorial shift against nuclear power, especially given the spate of news reports on environmental hazards associated with nuclear weapons plants. (The latter are different from civilian power plants, but public-opinion fallout is still likely to hurt the industry.)

But the threat of global warming is real, and the search for alternatives to fossil fuels remains urgent. Whether the answer lies in nuclear, solar, conservation, or some combination, risks have to be compared and claims by advocates on all sides questioned. Covering such a complicated story in depth will be a real challenge. Yo-yo journalism won't do it. ■

FRED JEROME is executive vice-president of the Scientists' Institute for Public Information.

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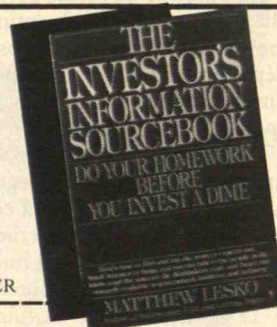
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BOOKS

Guerilla Warfare in the Lab

Animal Liberators

by Susan Sperling

University of California Press, \$19.95

BY JOHN RUBIN

In the last few years, the animal rights movement has traveled from the fringes of society to a position of growing visibility and influence. Activists have delayed the construction of academic laboratories, overturned laws that once allowed scientists to use pound animals, and pressured universities to stop certain kinds of research. Recently, for example, they persuaded Cornell University to return a major grant from the National Institute on Drug Abuse for a study of the physiology of barbiturate addiction in cats. In extreme cases, activists have dropped politics for guerrilla tactics and forcibly "liberated" laboratory animals.

Because the animal rights movement can no longer be ignored, *Animal Liberators: Research and Morality* is a timely book. Susan Sperling tries to put antivivisectionism into anthropological and historical perspective by comparing today's movement with one that arose in Great Britain a century ago, at the dawn of scientific animal experimentation. Powering both movements, she argues, is fear of a world disrupted and corrupted by technology.

Blurring Cosmological Boundaries

Following the theories of French anthropologist Claude Levi-Strauss, Sperling claims that all cultures try to make sense of the world by casting it in terms of fundamental dichotomies. These distinctions, or "cosmological boundaries," are crucial to ordering our experience. In Victorian Great Britain, says the author, advances in science and technology strained two of the most important boundaries in Western culture: the distinctions between technology and nature, on the one hand, and humans and animals, on the other.

For example, Darwin's theory of evolution proposed a single process of natural selection, valid for all species. The new science of physiology, based on an explicit analogy between animal and human organs, led



medical researchers to perform experiments on animal subjects and develop new technologies—in particular, vaccination and surgical techniques—for fighting human disease. In popular culture, pet-keeping, an innovation of urban industrial society, introduced a novel and confusing category in between human and animal—creatures that lived in the house, were called by human names, and were never eaten.

These growing pressures on traditional categories caused much anxiety. This was expressed mainly through opposition to animal experiments because, according to Sperling, there is no better symbol of nature under assault by technology than an animal in a scientist's apparatus. "As the physiologist cuts into the animal," she writes rather melodramatically, "he exposes nothing less than the gaping maw of the crisis"—the ruptured natural order. By opposing animal experimentation, antivivisectionists hoped to fight the gamut of frightening changes taking place around them.

According to Sperling, the United States today bears a close resemblance to Victorian England. Scientific and technological changes are battering cosmological boundaries to an unprecedented degree. New organisms are created in the laboratory while old species are extinguished as a side effect of novel technologies. Organs from pigs and monkeys, as well as artificial hearts, are transplanted into human bodies. Not timid about hyperbole, Sperling writes that contemporary Americans "feel as threatened and removed from power over their lives as

have tribal peoples" facing the destruction of their societies. And again the experimental animal has become the "symbolic nexus for all the damage wrought" by technology.

To back her claim that the animal rights movement taps into a broad current of anti-technology feeling, Sperling emphasizes how both Victorian and modern antivivisectionists have allied with other movements that question mainstream scientific practices. One example is the close historical ties between animal rights activism and feminism. Some feminists have criticized traditional gynecology as a form of vivisection, making their case with "horrifying images of female passivity under the knife of invasive male physicians."

Meat Eaters and "Vegans"

Although Sperling's historical and anthropological insights are provocative, her analysis of the animal rights movements lacks depth. Take her discussion of the links between the movement and feminism.

Sperling rightly points out that on the issue of abortion, the animal rights movement would seem to conflict with contemporary feminism. Like animal experimentation, abortion is "the destruction of living organisms through technological incursions." And the claim that the fetus has the same rights as other humans is not so different from the claim that animals have the same moral status as people. Both are radical attempts to extend human rights to new entities.

And yet antivivisectionists do not generally oppose abortion. Sperling notes this inconsistency but never bothers to explore it. Perhaps it reflects a conviction that the real victim of oppression in unwanted pregnancies is the woman, not the fetus. Perhaps it is simply a contradiction in the animal rights world view.

In a chapter of interviews with contemporary activists, Sperling succeeds in portraying the wide diversity of opinion among animal rights activists. Among her informants, one is a lawyer who eats meat and wears leather shoes, while another is a self-described "vegan" who shuns all animal products, even to the point of suffering through an infection rather than taking a drug derived from animal research. But she fails to ask the kind of questions that would allow her to draw a more complex portrait of these protestors' moral vision.

In particular, she neglects to describe the alternative cosmological boundaries that they propose. Do *all* organisms have an ab-

solute right to life? Does the anthrax bacillus have a right to reproduce? Does a tree have a right to grow? Should the very idea of distinctions among species be rejected?

Sperling believes that the animal rights movement not only reflects "deep anxieties about changing relationships among humans, animals, and machines" but also makes "rational criticisms of the cost of technology." Unfortunately, her evidence does not support the second part of this assertion. It's hard to know whether the fault lies with the activists themselves or with Sperling's portrayal of them, but not once do her interviews reveal a glimmer of rational discussion about technology's costs and benefits. Instead, her informants make vague, wide-ranging connections marked by oversimplification and a kind of moral absolutism.

One activist implies that "the testing of radioactive weapons on monkeys" leads to "the vivisection of the planet." Another explains that she prefers defending animal rights, as opposed to those of humans, because animals "are totally victimized." Since people often bear some responsibility for their own oppression, their cause is less pure.

In fact, the animal rights activists portrayed here resemble nothing so much as religious fundamentalists. Although the contents of the two perspectives are antithetical—fundamentalists give humans a privileged role in the universe, a role that animal rights proponents reject—their styles of thought are remarkably similar. Both movements avoid difficult moral choices; both are partial to a utopian discourse about a future golden age. According to Sperling, animal rights activists believe that stopping animal experimentation will "reverse the dangerous corruption in the human relationship to nature" and lead to "a millennium in which the human species lives once again in harmony with nature."

But while Sperling reports such viewpoints, she doesn't make much of them. She seems to have stumbled into a pitfall of the anthropological approach—excessive relativism. She presumes that the beliefs of the animal rights subculture are as consistent and rational as those of any other. This assumption leaves too many questions unasked and unanswered. ■

JOHN RUBIN, a science writer based in Berkeley, Calif., holds a Ph.D. in cognitive science from MIT.



FILM

How Soviet Cinema Went Hollywood

BY KAREN ROSENBERG

GLASNOST may offer the opportunity to recover the lost history of Soviet cinema. Whether the archives will finally be open to Western eyes remains to be seen. But more frequent contacts with Soviet directors and film historians are already revealing intriguing parallels between the development of that medium in the East and the West.

In the early years of film, avant-garde artists in many countries brought their utopian expectations to the new technology, hoping that cinema would be a visually sophisticated, revolutionary medium. But both moguls in the West and bureaucrats in the USSR soon realized the mass potential of film and turned it into a sentimental "easy read."

Art as Revolution

Soviet artists of the 1920s were fascinated by machines—their shapes, rhythms, and power. The influential Soviet theater director Vsevolod Meyerhold staged movements according to Frederick Winslow Taylor's time and motion analysis. In his photographic self-portrait "The Constructor," made in 1924, Soviet visual artist El Lissitzky used

superimpositions to unite hand, head, and compass. A group of technological enthusiasts in early post-revolutionary Russia known as constructivists influenced and responded to parallel art movements in Germany.

Like some of their Western counterparts who celebrated the power of the machine, many Soviet artists were revolutionaries, or at least sympathetic to the idea of rapid, violent change. A number of Soviet filmmakers saw themselves as combatants whose weapon was their art, and thus frequently accompanied their technological metaphors with military ones. "Mobile projectors are powerful tanks on the educational front," declared one Russian journalist in 1925. They function as "portable film machine-guns," said Anatoly Lunacharsky, a writer who served as the people's commissar of enlightenment—roughly the minister of culture and education—from 1917 to 1929.

Along with embracing images of battle, early Soviet film enthusiasts liked to compare the filmmaker to the proletarian. Clearly this gave cinema a central position in the modern era, especially in the "workers' state." The comparison is not entirely forced. Unlike some other more traditional arts, cinema has many parallels with modern industry. The camera is a machine, the film material must undergo various technological processes, and—as in industry—the work is done collectively. Little wonder then that Soviet filmmakers spoke of their studios as "film factories."

Of all the early Soviet filmmakers who pursued the idea of the camera operator as industrial worker, perhaps none was as insistent on this point as Denis Kaufman, known as Dziga Vertov. Even his pseudonym describes his orientation. As film historian Annette Michelson points out, "Vertov" is derived from the Russian verb "to spin or rotate," while the exotic "Dziga" reproduces the repetitive sound of a revolving camera crank.

Vertov's goal was to use film to "bring men closer to machines" by revealing "the souls of machines"—the lathe, the tractor, the engine, and, of course, filmmaking equipment. His 1929 silent film *The Man with the Movie Camera* is about the feats that a camera operator and a film editor can perform with their equipment. As Vlada Petrić, curator of the Harvard Film Archive, notes in a new book on Vertov, fast motion, reverse motion, dissolves, stroboscopic flickering, multiple exposure, and animation techniques such as pixillation (which shows a camera "walking" on its three legs) teach the

audience what marvels machines run by skilled craftspeople can produce.

What Vertov filmed using these techniques was Soviet society—real people, not actors, on the streets and on the job, relaxing and laboring. Reflecting the new frankness of the age of *glasnost*, one Soviet filmmaker recently told me that Vertov was a dishonest propagandist because he used his works to praise a state that failed to live up to its promises. But Petrić argues that Vertov aimed his camera at facts that Soviet apologists might have preferred to cover up. In *The Man with the Movie Camera*, a neat workers' club is practically deserted while a beer hall is crowded with rowdy customers. Badly clothed and handicapped people sleep on the streets while others have beds. Primitive carts and a dirty factory yard hint at poor working conditions and provide a stark contrast to well-dressed, bourgeois-looking Soviets such as ladies in a beauty salon. In this way Vertov uses editing to point to the existence of different social classes after the revolution.

Montage was the early name given to this film technique of creating meaning through juxtaposing shots. Although this foreign word sounded revolutionary, the principle was really similar to poetry, which brings together apparently disparate images.

But getting film accepted as art rather than low-brow entertainment proved difficult. Unsophisticated audiences and critics were largely unable to make sense of the dense *The Man with the Movie Camera*.

Visual Literacy

One response to this failure is to blame the filmmaker for producing elitist films. In fact, this charge was made in the USSR in the 1920s, and even more often in the 1930s and 1940s, against avant-garde directors. In a 1935 book *A Cinematography of the Millions*, Boris Shumyatsky, head of the Soviet film apparatus, called for relaxing, optimistic movies that made it "easier to work afterward" and heroes and plots that "the victorious class" could identify with.

In an attempt to keep working, some avant-garde directors reacted by making conciliatory, self-deprecating speeches. But Vertov, always polemical, refused to recant and fell into depression when Stalinist administrators rejected his film projects.

Perhaps the avant-garde of the 1920s unwittingly provoked its own destruction by declaring so forcefully that cinema was an industry. That could mean, à la Vertov, that

the camera was an exemplary machine and the camera operator a model worker. However, to others it spelled the need for box-office success that would justify large expenditures for equipment, film stock, studio space, and personnel. Of course, financial considerations were not the only barrier to continuing experimentation in Soviet cinema. The USSR under Stalin was just as intolerant of the avant-garde impulse—any works that the average critic, bureaucrat, or censor couldn't immediately understand—in painting and literature, art forms that required fewer rubles than film to produce.

Unfortunately, the creators of these works never made a convincing case for education that would permit audiences to appreciate difficult cinema. Perhaps Vertov and other revolutionary filmmakers overestimated their audience's level of visual literacy. The ability to read a film, like the capacity to analyze a poem, is a learned skill, one that could be taught in school. But in the USSR, as in the West, few children learn that cinema can be a branch of art rather than just a source of entertainment.

Love Stories and Adventure Plots

In the West, we are used to thinking of the USSR as our polar opposite. But Soviet cinema of the Stalin era contains less propaganda than Westerners might expect and more Hollywood-style tinsel. What won out was not just "politically correct film" but accessible film, with love stories and adventure plots that are standard formulae in Western commercial culture as well.

The study of Stalin-era filmmaking has only just begun. This cinema is still largely unknown in the United States, even to specialists in Soviet culture. But the age of *glasnost*, when Soviets themselves are filling in pages of their history, seems a good time to examine the transition from an avant-garde to an entertainment cinema in the USSR. As relations between the superpowers improve, we may be ready to perceive our points of convergence as well as our differences. ■

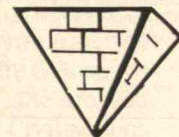
KAREN ROSENBERG, a writer with a special interest in Soviet culture, holds a Ph.D. in Slavic languages and literatures from Yale University. She has written on Soviet cinema for film periodicals in England, France, West Germany, and the United States.

and Sabel to promote organizational learning and reindustrialize depressed economies. For example, in Massachusetts, the Industrial Services Program is organizing "production networks" of small firms, which are encouraged to share technology, infrastructure, technical assistance, and even scarce skilled labor. The goal is to achieve economies of scale and scope more typical of the large multiplant corporation. Similar initiatives are under way in New York, Pennsylvania, and Michigan.

The trick is to get the more forward-looking large high-tech companies to participate. They have much to offer the small firms: as customers, sources of technical assistance, and go-betweens in helping them connect with export markets. Their participation will promote the realization that it isn't a question of small versus large firms. A successful development policy depends on both. ■

FLORMAN

CONTINUED FROM PAGE 16



opposition from his own superiors. Since the scheduled formal opening of the project was only days away, calamity loomed.

Meeting followed meeting as inspectors, consultants, contractors, building department officials, and eventually administrators and commissioners grappled with the problem. As tempers grew short and insults started to fly, I thought back to the naive assumptions of my school days. There was no professor to give us the right answer.

At the last minute, however, a scholar of sorts did appear to save the day. An old-timer, wise in the lore of the building code, informed us that if we posted a sign limiting occupancy to two hours, the community room would then fall under a different provision of the code. After filing an appropriate amendment with the Building Department, that is exactly what we did.

The opening ceremonies took place on schedule and, as fate would have it, they were held in the very community room that had nearly been our downfall. With the mayor and other politicians on hand, a band playing, and the room filled to capacity, I had a fleeting concern about the ventilation. But the air remained fresh and everybody smiled—including the engineers who had been at each other's throats only days before.

Luckily, the program was less than two hours long. Not that ventilation would have been a problem. But who knows from what quarter an engineer might have arrived bearing a notice of violation? ■

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Playing Crisis

The energy crisis in the winter of 1993 couldn't have been worse. After the Iran-Iraq ceasefire broke down, world oil prices jumped to \$36 per barrel. Then they threatened to climb higher. It looked like Japan might increase its demand for fossil fuels, since an earthquake had caused hair-line fractures in two nuclear reactors there. Meanwhile, scientists worldwide had agreed that global warming could be slowed only if people limited their use of fossil fuels. And to make matters worse, the United States—already rocked by growing inflation, trade imbalances, and diving stock-market prices—suffered a cold spell that made energy demands impossible to meet.

This drastic scenario provided a tough simulation exercise for 55 energy experts who recently met to hammer out in a day a plan that could make the United States less vulnerable to energy problems. The activity was developed by Lawrence E. Susskind, who is co-founder of the Program on Negotiation, a collaboration of MIT and Harvard and Tufts universities. Participants explored the value of negotiating seemingly intractable positions on national security, environmental quality, and other critical issues. Such notables as the governors of Wyoming and North Dakota and William D. Ruckelshaus, chairman of Browning-Ferris Industries and past administrator of the U.S. Environmental Protection Agency, played roles ranging from oil and gas lobbyists to consumer advocates and environmentalists.

In the end, the members of the "presidential Commission on America's Energy Future" developed only general proposals—such as reducing oil imports 3 percent annually. But participants "identified obstacles to building a consensus on national energy policy," Susskind says. And they realized that such an agreement must be reached before a crisis, when disputants would be "too worried about avoiding the worst outcome for their constituencies," according to a summary of the event.

The American Energy Assurance Council, which sponsored the exercise, was formed to bring together groups that differ on energy policy. The non-profit organization now wants to create a strategy for building a true national energy consensus.

Off to Venus

As space launches resume, the long and dispiriting wait is over for the MIT Center for Space Research (CSR). The \$700 million *Magellan* mission to Venus, for which CSR Director Gordon H. Pettengill is the principal investigator, is set to launch from the space shuttle *Atlantis* April 28. (See *Trends*, October 1988.)

The *Magellan* satellite should be in orbit 250 kilometers above Venus by late summer 1990, when it is expected to begin 243 days of mapping. It will send digitized terrain information to Earth "like a fire-hose delivering water to a fire," Pettengill says. The effort should create a map that shows features the size of a city block on 80 percent of Venus, which is usually hundreds of millions of miles away.

Drawing on experience gained from the recent flight of the Daedalus human-powered aircraft, Andreas von Flotow, MIT aeronautics and astronautics professor, and John Langford, Daedalus project manager, are trying to figure out whether a lightweight airplane could serve as an inexpensive communications platform over a city. The plane might be used for relay-

telephone, paging services, and data-transmission communications. Its engine would need just 3,000 watts of electricity, supplied by solar panels.

The 600-pound craft, which would be guided remotely, would fly about 70 miles an hour 60,000 feet above the earth in circles to maintain its position. First calculations suggest that there would be a one-in-a-million

chance per year that at this altitude a major gust could "trash the airplane," von Flotow says.

The two engineers speculate that the plane would cost anywhere from \$5 million to \$25 million. Comparisons have yet to be made with other communications devices such as satellites and the system of ground antennas now used for mobile telephones.



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For more than a year, students working with the MIT Sea Grant Program have been developing a human-powered submarine that will compete in a one-kilometer race this June in West Palm Beach. Two people, including a pilot, will lie on their backs in the sub, which will probably move at five to seven knots under pedal power, says Clifford A. Goudey, project advisor and fisheries engineer.

Human-powered subs based on the students' designs might help scuba divers who want to travel quickly. Such subs, which would be inexpensive, would have much less drag than a swimmer and could generate much more power, Goudey says.

Burrow, Don't Build

Concrete moguls, get ready to diversify into rock-melting technology. If humans build permanent settlements on the moon in the next 50 years, they won't be using concrete for large-scale construction projects, says Ranko Bon, associate professor in the MIT Department of Architecture.

Although experiments with lunar materials indicate that concrete could be made with local soil and rocks, the scarcity of available water would limit production. Shipping water from Earth would not be a good solution, since it would cost too much. Also, because water would not evaporate as easily on the moon, much more energy would be needed to cure the concrete.

For the near future, the answer is partially or completely underground "warrens" tunneled out with rock-melting technology, Bon says. Not only would these structures protect human beings from solar and cosmic radiation, but the technology has been tested on a small scale on Earth.

Computer Translation

The United States should strive to develop a translating telephone so that people using different languages can speak directly

with one another. This challenge, put forth by the Computer Science and Technology Board of the National Research Council, would require programs that incorporate thousands of basic principles of grammar for each language. While the speakers of any language instinctively understand these rules, no one has yet described all of them.

Within 10 years researchers will be able to produce an electronic dictionary that includes the critical principles of grammar

for a significant portion of the English language. So predicts S. Jay Keyser, who's working on this project with fellow MIT linguistics professor Kenneth L. Hale. The two professors became interested in the idea while developing a grammar-based dictionary for Warlpiri, an Australian aboriginal language they are trying to help preserve.

Although comprehensive grammar principles will make learning English easier, Keyser believes the dream of complete translation by computer will remain just that. Probably 20 percent of a message could never be automatically translated. While 80 percent comprehension might be enough for some scientific information, Keyser says computer translation will never work for novels, poetry, or declarations of love.

MIT in TR...

When most people think of MIT, agricultural research does not come immediately to mind. Yet we first learned about work by George E. Seidel, Jr., on animal-breeding biotechnologies when he was on sabbatical at the MIT-affiliated Whitehead Institute for Biomedical Research. Seidel was studying "primordial germ cells"—embryonic cells that are the precursors of sperm and eggs. "That research was so cutting edge," Seidel recalls, "that we got no results." On page 42 he describes other breaking research he is conducting that may be more promising.

M. Anjali Sastry, Joseph J. Romm, and Kosta Tsipis explain in detail on page 22 how a few nuclear blasts would damage the

economy. Tsipis, director of MIT's Program on Science and Technology for International Security, worked with his co-authors while they were students at MIT. Sastry received S.B. degrees in physics and Russian in 1986, and Romm completed his doctorate in physics in 1987.

And last summer, Hugh Carter Donahue, a research associate in the MIT Political Science Department's program on communications policy, spoke at length with MIT electrical engineering professor William Schreiber about high-definition television (HDTV). Our package on HDTV starts on page 30 and includes an interview with Schreiber, director of the Advanced Television Research Program at the Media Lab, and an article by Donahue.

MIT Reporter continues on page 79

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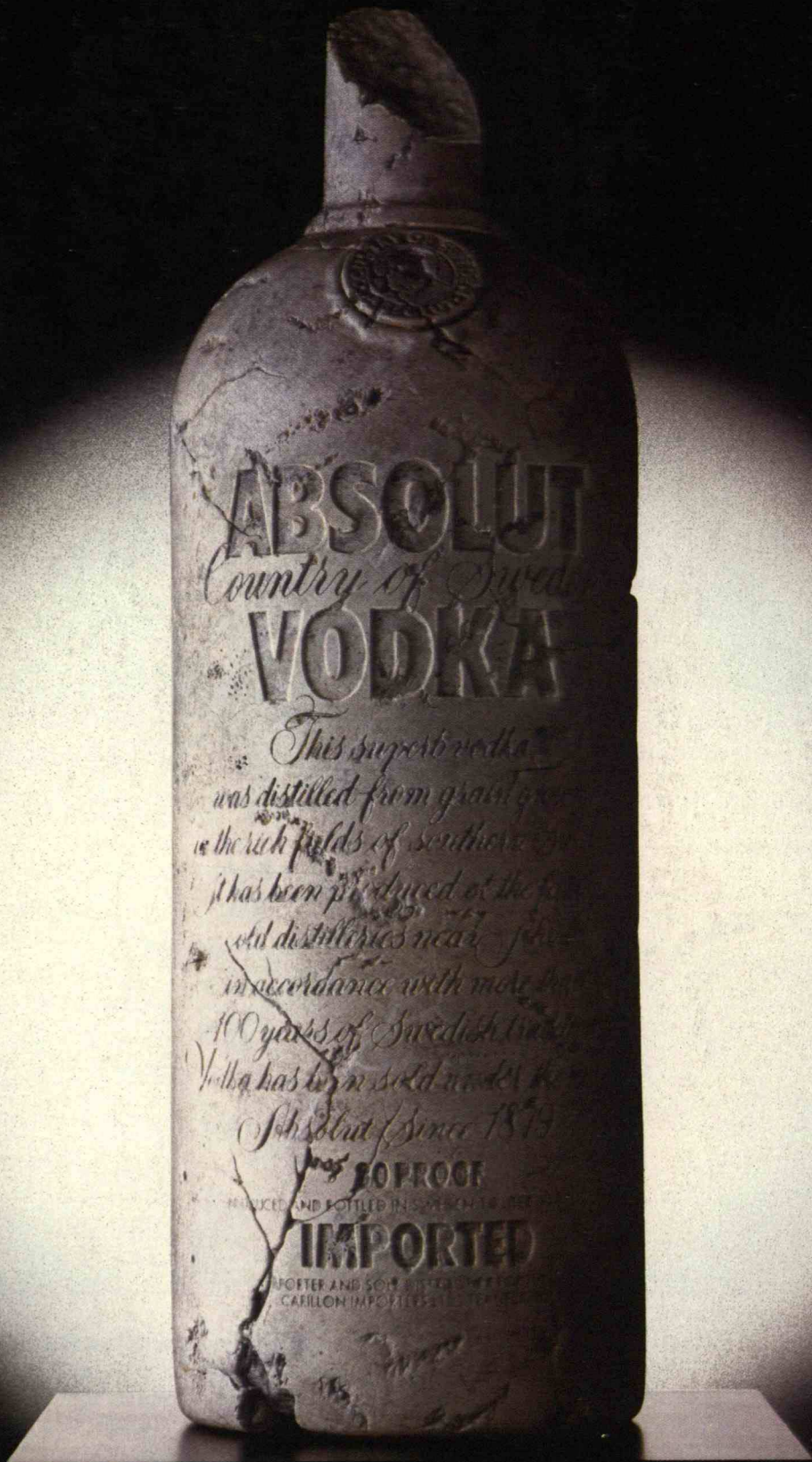
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